Am J Transl Res 2024;16(8):3812-3821
www.ajtr.org /ISSN:1943-8141/AJTR0156844

*Original Article*

# Effect of trapezoidal excision combined with modified embedded vertical mattress suture technique on postoperative scar formation after cesarean section

Yudi Xie[1,2,3,4], Yiling Chen[1,2,3,4], Yihuang Hong[1,2,3,4], Qionghua Chen[1,2,3,4]

*[1]Clinical Research Center for Gynecological and Reproductive Health of Fujian Province, Xiamen 361000, Fujian, China; [2]Clinical Medical Research Center for Obstetrics and Gynecology Diseases of Fujian Province, Xiamen 361000, Fujian, China; [3]Laboratory of Research and Diagnosis of Gynecological Diseases of Xiamen City, Xiamen 361000, Fujian, China; [4]Department of Obstetrics and Gynecology, The First Affiliated Hospital of Xiamen University, School of Medicine, Xiamen University, Xiamen 361000, Fujian, China*

Received March 27, 2024; Accepted June 13, 2024; Epub August 15, 2024; Published August 30, 2024

**Abstract:** To study the impact of modified embedded vertical mattress suture technique in conjunction with trapezoidal resection on the formation of scars after cesarean section. This retrospective study involved 339 pregnant women who had cesarean sections at the Department of Obstetrics and Gynecology, the First Affiliated Hospital of Xiamen University from September 2020 to August 2023. Among them, 150 patients who received traditional subcutaneous fat layer discontinuous suture during September 2020 and June 2022 were assigned to the control group, and 152 patients who received improved buried vertical mattress suture technique and trapezoidal resection between July 2022 and August 2023 were assigned to the observation group. The therapeutic effect, surgical parameters and cosmetic effects in the two groups were compared. The suture time of the observation group was longer than that of the control group (t=27.858, P<0.001). The grade A healing rate (96.05%) and cosmetic satisfaction rate (94.08%) in the observation group were significantly higher than those (76.00% and 74.00%) in the control group (all P<0.001); while the incidences of suture reaction (12.05%), complication (1.96%), and hypertrophic scar (5.26%) were significantly lower than those in the control group (38.00%, 22.00%, and 27.33%, respectively) (all P<0.001). The visual analogue scale (VAS) score in the observation group was lower than that of the control group (intergroup effect: F=1434.000, P<0.001; time effect: F=91.091, P<0.001; interaction effect: F=2.409, P=0.091). The postoperative VSS score and scar width in the observation group were lower than those in the control group (all P<0.001). Multivariate analysis showed that complications (P=0.006) and suture method (P=0.016) were independent influencing factors for the occurrence of hypertrophic scars in pregnant women. Trapezoidal resection combined with improved buried vertical mattress suture technique can promote incision healing, reduce suture reaction, incision pain, adverse complications and the incidence of hyperplastic scar, and improve the cosmetic effect of surgery.

**Keywords:** Trapezoidal excision, improved embedding vertical mattress suture technology, cesarean section, scarring

## Introduction

According to the guidelines set forth by the World Health Organization, the cesarean section rate should be maintained within the range of 10% to 15% [1]. However, China has the highest cesarean section rate in the world, exceeding 40% in large cities and even reaches 80% in certain areas. With recent changes in China's birth policy and lifestyle diet structure, there has been an increase in high-risk pregnancy groups, leading to a growing clinical application of cesarean sections. As a result, the prevention and treatment of cesarean section related complications has become an important focus of clinical research [2-4]. Additionally, the increasing emphasis on aesthetic outcomes, particularly among young women, has heightened focus on the appearance of the abdominal incision post-cesarean. The scarring, flat-

https://doi.org/10.62347/MGKQ5295

ness, and restoration of the functional morphology of the incision after a cesarean section all impact the subjective perception of patients. The most unacceptable postoperative scar for patients is clearly noticeable scarring [5]. How to reduce the formation of incision scar after cesarean section has become the focus of clinical research.

Studies have shown that factors influencing incision healing and scarring formation include the choice of skin incision, incision tension, suture material, degree of tissue damage, the patient's general condition, local vascularity, and the patient's constitution [6, 7]. Among these, wound tension is a critical determinant of healing quality and scar formation [8]. Continuous tension on both sides of the incision can aggravate local inflammatory response, induce angiogenesis, and increase collagen synthesis. In addition, it also accelerates the accumulation of dextran, leading to pronounced scar hyperplasia [9]. Therefore, sufficient tension-free closure of the incision is an important measure to promote the smooth healing of the incision and prevent scar tissue hyperplasia [10]. While traditional subcutaneous fat layer intermittent suture technique can effectively close the incision, it may lead to scar tissue formation, which diminishes aesthetic outcomes and affects the psychological status of the mothers [11]. Trapezoidal resection and modified buried vertical mattress suture technique is a relatively novel tension-reducing suture technique applied in plastic surgery in recent years [12, 13]. However, there are few reports about whether trapezoidal resection combined with modified buried vertical mattress suture technique can better reduce postoperative scarring in pregnant women after cesarean section. This study investigated the effect of trapezoidal resection combined with modified buried vertical mattress suture technique on scar formation after cesarean section.

## Materials and methods

### *Basic information*

This study was approved by the Ethics Committee of the First Affiliated Hospital of Xiamen University. This retrospective study initially comprised 339 pregnant women who underwent cesarean section in the Department of Obstetrics and Gynecology at the First Affiliated Hospital of Xiamen University from September 2020 to August 2023.

Inclusion criteria: (1) Indications for cesarean section; (2) Full term single pregnancy; (3) Complete clinical data, including baseline data, surgical treatment, course records, and postoperative data; (4) First cesarean section.

Exclusion criteria: (1) Pre-existing conditions such as diabetes, hypertension, cancer, blood coagulation dysfunction, immune dysfunction, or chronic skin diseases that could affect incision healing; (2) Serious organ dysfunction involving the heart, lung, liver, or kidney; (3) Any critical intraoperative or postoperative complications, including uterine cavity infections; (4) Cognitive impairment or mental abnormalities; (5) Scar constitution. Finally, 302 cases of cesarean section were included in this study according to the inclusion and exclusion criteria. Of these, 150 patients treated from September 2020 to June 2022 using the traditional subcutaneous fat layer discontinuous suture technique formed the control group, and the rest 152 patients treated from July 2022 to August 2023 constituted the observation group.

### *Methods*

In both groups, combined lumbar epidural anesthesia was administered. The abdominal wall incision was made vertically, and the cesarean section was performed using conventional techniques. Uterine incision closure, abdominal wall and fascia suture methods, as well as suture materials were consistent between the two groups. The incision site was irrigated with normal saline and the surrounding skin was disinfected with iodophor.

In the observation group, trapezoidal resection combined with an improved vertical mattress suture technique was performed on the abdominal wall incision involving the fat layer and subcutaneous layer. And the specific operations were as follows: 1) A trapezoidal excision of subcutaneous tissue was performed, angling the cuts towards the center to form an "isosceles trapezoid" shape on the cross-section of the incision. 2) After removing the appropriate

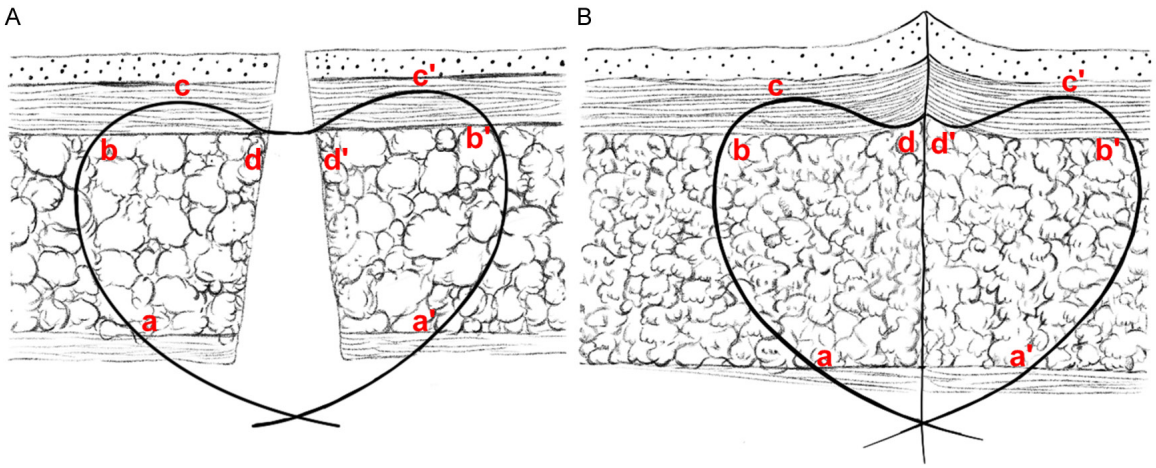


**Figure 1.** Trapezoid resection combined with modified buried vertical mattress suture technique. A. Trim trapezoidal incision; B. Suture the subcutaneous fat.

amount of subcutaneous tissue, markers were placed symmetrically on both sides of the incision at points a, b, c, d and a', b', c', d', as shown in **Figure 1**. 3) Suturing was performed using 2-0 antibacterial Vecchio eight-needle absorbable thread (VCP739D) by ETHICON. The suture process involved inserting the needle at point a, and reentering at point b, with the needle emerging at the junction of the dermis and subcutaneous layer at point d. The distance between points b and d was approximately 1-1.2 cm. 4) The suture was executed symmetrically on the opposite side of the cut, maintaining a "deep and shallow, shallow and deep" pattern for the intermittent stitches. The distance between stitches was around 1-1.2 cm, with a longer span between points b and b' compared to traditional techniques. The sutures formed an arched line in the dermis, peaking at points c and c', which did not rise above the middle dermal papillary layer.

In contrast, the control group employed the traditional subcutaneous fat layer discontinuous suture technique using 3-0 absorbable suture. The suture needle was inserted into the dermis on one side of the wound margin, penetrated through the whole layer, from the deep side of the tissue to the corresponding point on the opposite side, and knotted in the subcutaneous dermis. The suture interval was adjusted according to the length of incision and the bleeding of fat layer.

For both groups, skin incisions were closed with continuous suturing using 4-0 antibacterial Vicryl absorbable suture. Post-operatively, pain was managed with an intravenous analgesic pump for 48 hours, and the abdominal incision was supported with a sandbag for 6 hours.

*Data collection*

The clinical data of pregnant women were collected by the investigators through the means of reading medical records, filling in the transfer form and telephone supplement.

The collected data encompassed various aspects, including age, gestational age, body mass index (BMI), incision length, suture time, skin margin height on the day after surgery, incision healing, surgery-related complications, pain at incision site, surgical scars, scar width, hypertrophic scars and aesthetic satisfaction.

*Observation indicator*

The primary outcomes of this study included surgical scar condition, scar width, and hypertrophic scar incidence, while the secondary results included incision healing condition, surgery-related parameters, incision pain degree, complications, aesthetic satisfaction, and analysis of influencing factors of hypertrophic scar.

Surgical scar status: The Vancouver Scar Scale (VSS) [15] was used to evaluate postoperative scar status (3 months). The VSS score evaluates scars from four dimensions: flexibility, thickness, vascularity, and pigmentation, with a total score of 15. A higher score indicates a more severe scar.

Scar width and hypertrophic scar: The scar width and hypertrophic scar (defined as a scar wider than 1 mm, with rough surface, internal nodules and hard mass, and color significantly different from normal skin) were recorded 3 months after operation.

Operative parameters: Incision length, suture time and postoperative skin margin height were compared between the two groups.

Incision healing: The incision healing in the two groups (within 1 month), including healing time, incision healing grade (grade A: excellent healing, no adverse reactions in initial healing; grade B: normal healing, with inflammatory reaction but no suppuration at the healing site; grade C: purulent incision requiring incision and drainage) and suture reaction (grade 0: no reaction; grade I: palpable induration, but significantly relieved after the suture removal; grade II: visible and raised induration, slightly painful; grade III: markedly red and swollen, accompanied by a small amount of pus and severe pain) were recorded and compared between the two groups.

Complications: The incision complications such as incision exudation, redness and swelling, and thread knot reaction within 1 month after surgery were compared between the two groups.

Incision pain degree: Visual analogue scale (VAS) [14] was used to evaluate the pain degree at the incision site 1 month after surgery, ranging from 0 (no pain) to 10 (severe pain). 0-3: mild pain, 4-6: moderate pain, and 7-10: severe pain.

Cosmetic satisfaction: The self-made nursing satisfaction questionnaire of our hospital was used to evaluate the satisfaction of incision cosmetic. The total score was 100, with >90 being satisfied, 60-90 being relatively satisfied, and <60 being dissatisfied. Satisfaction rate = (satisfied + relatively satisfied)/total number of cases × 100%.

*Data processing methods*

SPSS 24.0 statistical software was used for data processing. Measurement data (in accordance with the normal distribution) were expressed as mean ± standard deviation, and t-test was used. The measurement data at multiple time points were analyzed by repeated measurement ANOVA. Count data were expressed as rate (%), and $\chi^2$ test was used for comparison. Multiple Logistic regression analysis was used to explore the influencing factors of hypertrophic scar formation after cesarean section. P<0.05 indicated that the difference was statistically significant.

## Results

*Maternal clinical features*

From September 2020 to August 2023, 339 pregnant women with cesarean section were admitted to the Department of Obstetrics and Gynecology of our hospital. Of these, 37 cases were excluded for the following reasons: 10 had previous cesarean section, 6 were not full-term, 5 were non-singleton pregnancies, 10 had incomplete clinical data, and 6 had only partial outcome evaluation after surgery. As a result, 302 women with cesarean section were eventually included (**Figure 2**). The patients were divided into an observation group (n=152) and a control group (n=150) according to suture methods. The observation group ranged in age from 17 to 36 years, with an average age of 28.11±3.77 years. The minimum and maximum gestational weeks were 36 weeks and 42 weeks, with an average of 39.33±1.17 weeks. Body mass index (BMI) ranged from 21.09 to 36.44 kg/m$^2$, with an average of 27.94±3.36 kg/m$^2$. The control group ranged in age from 18 to 40 years, with an average age of 29.03±5.05 years. The minimum and maximum gestational weeks were 36 weeks and 42 weeks, with an average of 39.11±1.49 weeks. BMI ranged from 21.04 to 36.91kg/m$^2$, with an average of 27.87±3.08 kg/m$^2$. Baseline data of age (t= 1.797, P=0.073), gestational age (t=1.440, P=0.151) and BMI (t=0.193, P=0.847) were compared between the two groups.

*Comparison of incision length, suture time and skin margin height on the day after surgery between the two groups*

As shown in **Table 1**, there was no significant difference in incision length and skin margin height between the two groups (P=0.073; P= 0.158). The suture time of observation group was longer than that of control group (P<0.001).

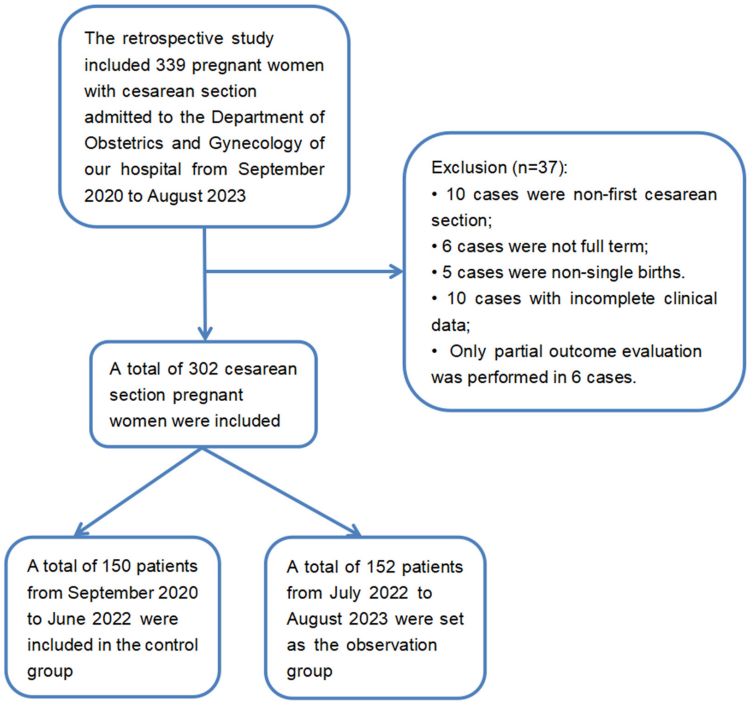


**Figure 2.** Flowchart of subject enrollment.

**Table 1.** Comparison of incision length, suture time and skin margin height on the day after surgery between the two groups

| Group | Incision length (cm) | Suture time (min) | Skin margin height (cm) |
|---|---|---|---|
| Observation group (n=152) | 9.89±1.09 | 14.45±2.30 | 0.64±0.20 |
| Control group (n=150) | 10.05±1.20 | 8.51±1.24 | 0.61±0.16 |
| *t* | 1.797 | 27.858 | 1.416 |
| *P* | 0.073 | <0.001 | 0.158 |

*Comparison of incision healing and suture reaction between the two groups within 1 month*

As shown in **Table 2**, compared with the control group, Grade A incision healing rate (96.05% vs 76.00%) was significantly higher while the total incidence of suture reaction (12.5% vs 38.00%) was significantly lower in the observation group (both P<0.001).

*Comparison of incidence of incision complications between the two groups*

As shown in **Table 3**, the total incidence of complications in the observation group was 4.61%, which was significantly lower than 14.00% in the control group (P<0.05).

*Comparison of postoperative VAS scores between the two groups*

As shown in **Table 4**, the VAS score of the observation group was significantly lower than that of the control group (intergroup effect: F=1434.000, P<0.001), and the VAS score of both the observation group and the control group decreased over time (time effect: F=91.091, P<0.001), and there was no interaction between the groups and time (interaction effect: F=2.409, P=0.091).

Multiple comparison results of VAS scores at each time point between the observation group and the control group showed that there were significant differences in VAS scores between the two groups at each time point (all P<0.001), as shown in **Table 5**.

*VSS score, scar width and hypertrophic scar occurrence were compared between the two groups 3 months after operation*

As shown in **Table 6**, the VSS score, scar width and incidence of hypertrophic scar 3 months after operation in the observation group were all lower than those in the control group (all P<0.001).

*Comparison of cosmetic satisfaction between the two groups*

The cosmetic satisfaction rate in the observation group was 94.08%, which was significantly higher than 74.00% in the control group (P<0.001), as shown in **Table 7**.

*Analysis of influencing factors of hypertrophic scar formation after cesarean section*

In this study, 49 cases out of 302 pregnant women exhibited hyperplastic scar 3 months

**Table 2.** Comparison of incision healing and suture reaction between two groups within 1 month

| Group | Incision healing grade | | | Grade A healing rate (%) | Suture reaction | | | | Total incidence (%) |
|---|---|---|---|---|---|---|---|---|---|
| | Class A | Class B | Class C | | Grade 0 | Grade I | Grade II | Grade III | |
| Observation group (n=152) | 146 (96.05)* | 6 (3.95) | 0 (0.00)* | 146 (96.05) | 133 (87.50)* | 19 (12.50) | 0 (0.00)* | 0 (0.00) | 19 (12.50) |
| Control group (n=150) | 114 (76.00) | 30 (20.00) | 6 (4.00) | 114 (76.00) | 93 (62.00) | 26 (13.33) | 27 (18.00) | 4 (26.67) | 57 (38.00) |
| $t/\chi^2$ | 25.355 | 18.529 | 6.122 | 25.926 | 26.068 | 1.391 | 30.046 | 4.108 | 26.068 |
| *P* | <0.001 | <0.001 | 0.013 | <0.001 | <0.001 | 0.238 | <0.001 | 0.043 | <0.001 |

Note: *compared with the control group, P<0.001.

**Table 3.** Comparison of incision complications between the two groups

| Group | Incision exudate | Redness | Knot reaction | Total incidence |
|---|---|---|---|---|
| Observation group (n=152) | 1 (0.66) | 3 (1.97) | 3 (1.97) | 7 (4.61) |
| Control group (n=150) | 11 (7.33) | 9 (6.00) | 13 (8.66) | 33 (22.00) |
| $\chi^2$ | | | | 19.880 |
| *P* | | | | <0.001 |

**Table 4.** Comparison of VAS scores on post-operative 1 day, 1 week and 1 month between the two groups

| Group | 1 day after surgery | 1 week after surgery | 1 month after surgery | $F_{interaction}$, $P_{interaction}$ | $F_{interclass}$, $P_{interclass}$ | $F_{time}$, $P_{time}$ |
|---|---|---|---|---|---|---|
| Observation group (n=152) | 5.59±1.44 | 3.18±1.03 | 0.61±0.69 | 2.409/0.091 | 1434.000/<0.001 | 91.091/<0.001 |
| Control group (n=150) | 6.49±1.49 | 4.03±1.17 | 1.12±1.13 | | | |
| *t* | -5.382 | -6.701 | -4.784 | - | - | - |
| *P* | <0.001 | <0.001 | <0.001 | - | - | - |

**Table 5.** Comparisons of VAS scores among different time points (Bonferroni)

| Group | (I) Time | (J) Time | Difference of mean (I-J) | Standard error | *P* | 95% CI | |
|---|---|---|---|---|---|---|---|
| | | | | | | Lower limit | Upper limit |
| Observation group | | | | | | | |
| | 1 day after surgery | 1 week after surgery | 2.401 | 0.126 | <0.001 | 2.099 | 2.704 |
| | | 1 month after surgery | 4.980 | 0.126 | <0.001 | 4.678 | 5.283 |
| | 1 week after surgery | 1 day after surgery | -2.401 | 0.126 | <0.001 | -2.704 | -2.099 |
| | | 1 month after surgery | 2.579 | 0.126 | <0.001 | 2.276 | 2.882 |
| | 1 month after surgery | 1 day after surgery | -4.980 | 0.126 | <0.001 | -5.283 | -4.678 |
| | | 1 week after surgery | -2.579 | 0.126 | <0.001 | -2.882 | -2.276 |
| Control group | | | | | | | |
| | 1 day after surgery | 1 week after surgery | 2.460 | 0.147 | <0.001 | 2.107 | 2.813 |
| | | 1 month after surgery | 5.373 | 0.147 | <0.001 | 5.020 | 5.727 |
| | 1 week after surgery | 1 day after surgery | -2.460 | 0.147 | <0.001 | -2.813 | -2.107 |
| | | 1 month after surgery | 2.913 | 0.147 | <0.001 | 2.560 | 3.267 |
| | 1 month after surgery | 1 day after surgery | -5.373 | 0.147 | <0.001 | -5.727 | -5.020 |
| | | 1 week after surgery | -2.913 | 0.147 | <0.001 | -3.267 | -2.560 |

after caesarean section. Univariate and multivariate analysis was conducted according to whether the women had hypertrophic scars (with =1, without =0). The results showed that complications (P=0.006) and suturing methods (P=0.016) were independent influencing factors for hypertrophic scar formation in women with cesarean section (**Table 8**).

**Table 6.** Comparison of VSS score and scar width 3 months after operation between the two groups

| Group | VSS score (points) | Scar width (mm) | Hypertrophic scar formation (%) |
|---|---|---|---|
| Observation group (n=152) | 4.12±1.05 | 0.38±0.11 | 8 (5.26) |
| Control group (n=150) | 6.64±1.33 | 0.98±0.21 | 41 (27.33) |
| $t/\chi^2$ | 18.334 | -30.720 | 27.054 |
| *P* | <0.001 | <0.001 | <0.001 |

**Table 7.** Comparison of cosmetic satisfaction between the two groups

| Group | Satisfied | Relatively satisfied | Dissatisfied | Total satisfaction rate |
|---|---|---|---|---|
| Observation group (n=152) | 90 (59.21) | 53 (34.87) | 9 (5.92) | 143 (94.08) |
| Control group (n=150) | 48 (32.00) | 63 (42.00) | 39 (26.00) | 111 (74.00) |
| $\chi^2$ | | | | 32.383 |
| *P* | | | | <0.001 |

**Table 8.** Analysis of influencing factors of hypertrophic scar formation after cesarean section

| Index | Single-factor | | Multi-factor | |
|---|---|---|---|---|
| | HR (95% CI) | P | HR (95% CI) | P |
| Age (years) | 0.960 (0.896-1.030) | 0.256 | - | - |
| Gestational age (weeks) | 1.142 (0.898-1.452) | 0.280 | - | - |
| BMI (kg/m$^2$) | 1.052 (0.957-1.156) | 0.292 | - | - |
| Incision length (cm) | 1.011 (0.775-1.321) | 0.934 | - | - |
| Suture time (min) | 0.794 (0.710-0.888) | <0.001 | 1.035 (0.834-1.283) | 0.756 |
| Skin margin height on postoperative day (cm) | 0.621 (0.115-3.355) | 0.580 | - | - |
| Complication | 4.626 (2.229-9.603) | <0.001 | 6.828 (1.440-6.335) | 0.006 |
| Stitching pattern | 6.771 (3.050-15.029) | <0.001 | 6.828 (1.440-32.371) | 0.016 |

## Discussion

Studies have shown that the repair of skin wounds after cesarean section is affected by a variety of factors, such as epithelial cell proliferation, increased local inflammation, and formation of new granulation tissue. Any repeated irritation at any stage can affect the incision healing, exacerbate the scarring of patients, and significantly affect the aesthetic appearance of the skin [16-18]. The traditional cesarean section incision suture uses the intermittent suture technique of the subcutaneous fat layer, which is effective to the incision closure, but still leaves a large tension on the dermis and epidermal tissues on both sides of the incision. In addition, sutures can cut into epidermal tissue, and the suture knot placed under the skin can compress the incision tissue and adipose tissue, resulting in suboptimal postoperative healing of the incision and more pronounced scar tissue formation, detracting from the cosmetic appearance of the incision site [5, 19]. Studies have shown that less than 35% of women are satisfied with scar after traditional suturing, and the pain at incision site after traditional suturing can be as high as 20% [13, 14]. Therefore, continuous improvement of subcutaneous incision suture technique is the key to improving the incision healing quality, with focus on minimizing scar tissue hyperplasia.

In recent years, trapezoidal excision combined with modified buried vertical mattress suture technology has been implemented in various surgical sutures. This method involves trimming the incision removing a portion of the superficial subcutaneous tissue to shape the incision margins into an “isosceles trapezoid”. This approach reduces the tension at the incision, allowing the epidermis to fully lift and the incision edge to turn out moderately, which evenly disperses skin tension across the contact surface and minimizes the impact on the blood circulation of the incision, creating a favorable environment for incision healing, re-

ducing the degree of scarring, and thus achieving less and even no scarring and improving maternal satisfaction [20, 21]. Our study showed that there was no difference in incision length and limbal height on the day of surgery between the two groups, while the suture time in the observation group was longer than that in the control group, suggesting that trapezoidal excision combined with modified buried vertical mattress suture technology had no advantage over traditional interrupted suture in terms of incision length and margin height control on the day after surgery, and it caused more complex operation and longer operation time. However, within one month after surgery, the incision healing in the observation group was better, the suture response was milder, and the postoperative complications were fewer, suggesting that trapezoidal resection combined with the modified buried vertical mattress suture technique could promote incision healing and reduce the complications. The advantages of trapezoidal excision combined with modified buried vertical mattress suture technique include: (1) The trapezoidal excision facilitates the full valgus of the skin margin upon closure, enhancing the alignment and appearance of the incision. (2) Trapezoidal resection increases the contact area of the dermis on both sides of the incision margin, which is conducive to the reconstruction of blood supply. (3) The specific suturing path not only ensures no foreign bodies remain in the dermis at the incision margin, but also aligns the incision accurately, reduces the knot reactions and inflammatory stimulation, thus minimizing irritation of the dermis at the incision margin [22]. (4) The needle was maneuvered deep within the dermis, capturing more dermal tissue, which not only secures the incision margin more effectively but also significantly reduces the impact on blood circulation due to the broad outward expansion at the reduction focus point [5].

Scar tissue, a natural byproduct of skin tissue repair process, not only affects skin beauty and increases pain, but also affects postoperative rehabilitation process and increases medical costs. Liu et al. [12] found that compared with intradermal threads, the modified buried vertical mattress sutures had a larger average valgus height and width, narrower scar width, and lower Patient and Observer Scar Assessment Scale (POSAS), VSS, and VAS scores. The results of this study found that the VAS score, VSS score, scar width and incidence of hyperplastic scar in the observation group were all significantly lower than those in the control group after surgery, and the aesthetic satisfaction in the observation group was significantly higher than that in the control group. These results suggest that trapezoidal resection combined with improved buried vertical mattress suture technique for cesarean section can effectively reduce incision pain, reduce the incidence of hyperplastic scars, and improve the cosmetic satisfaction of the patients.

In clinical surgical wound healing studies, the adverse impact of hypertrophic scar healing on patients extends beyond aesthetic appearance; symptoms such as itching and burning pain greatly affects patient quality of life [23, 24]. This study further carried out univariate and multivariate analyses to explore the factors influencing hypertrophic scar after cesarean section. The results showed that complications and suture methods were the influencing factors for hypertrophic scar formation after cesarean section. The rationale behind these findings is rooted in the complex biological process of incision healing post-cesarean section. Adverse reactions such as postoperative suture reaction, redness and fluid accumulation at the incision site can lead to poor incision healing and prone to the formation of hypertrophic scars. Employing a trapezoidal resection technique, which involves the removal of a small amount of subcutaneous fat, can alleviate local tension by reducing subcutaneous volume. This is complemented by parallel padding tensioning sutures placed deep in the dermis, which promote an outward bulging of the incision, effectively minimizing excessive tension. Fundamentally, it is a preventive internal tension reduction suture, which reduces the risk of incision infection, subcutaneous fat liquefaction in the incision area, incisional hernia, incisional dehiscence and secondary surgical suture [25]. By burying the suture knots deep within the subcutaneous tissue, this approach minimizes the likelihood of foreign body reactions and prevents the exposure of sutures. It also ensures a more even incision, reduces the interference and stimulation of the thread on the tissue healing, and effectively inhibits the abnormal proliferation of cells, thus reducing the formation of scar tissue.

## Conclusion

The trapezoidal resection combined with improved buried vertical mattress suture technique may extend the suture time during cesarean section. However, it offers enhanced healing outcomes, reduced adverse complications and suture reactions, less incision pain, fewer incidence of hyperplastic scars, and improved surgical cosmetic satisfactions, compared with the traditional subcutaneous fat layer intermittent suture technique, making it a preferable choice in cesarean section procedures for enhancing patient care and satisfaction.

## Disclosure of conflict of interest

None.

**Address correspondence to:** Qionghua Chen, Department of Obstetrics and Gynecology, The First Affiliated Hospital of Xiamen University, No. 55, Zhenhai Road, Siming District, Xiamen 361000, Fujian, China. Tel: +86-0592-2137306; E-mail: cqh66660320@163.com

## References

[1] King TL. The effectiveness of midwifery care in the world health organization year of the nurse and the midwife: reducing the cesarean birth rate. J Midwifery Womens Health 2020; 65: 7-9.

[2] Yan J, Wang L, Yang Y, Zhang Y, Zhang H, He Y, Peng Z, Wang Y, Wang Q, Shen H, Zhang Y, Yan D, Ma X and Yang H. The trend of caesarean birth rate changes in China after 'universal two-child policy' era: a population-based study in 2013-2018. BMC Med 2020; 18: 249.

[3] Xia X, Zhou Z, Shen S, Lu J, Zhang L, Huang P, Yu J, Yang L, Wang P, Lam KH, Jacobsson B, Mol BW, Xia H and Qiu X. Effect of a two-stage intervention package on the cesarean section rate in Guangzhou, China: A before-and-after study. PLoS Med 2019; 16: e1002846.

[4] Liu X, Huang D, Wang Y, Gao Y, Chen M, Bai Y, Wu M, Luo X and Qi H. Birth and birth-related obstetrical characteristics in southwestern China associated with the current adjustment of family planning policy: a 7-year retrospective study. Sci Rep 2020; 10: 15949.

[5] Yang J, Kim KH, Song YJ, Kim SC, Sung N, Kim H and Lee DH. Cosmetic outcomes of cesarean section scar; subcuticular suture versus intradermal buried suture. Obstet Gynecol Sci 2018; 61: 79-87.

[6] Zhang Y, Chen L, Zhou M, Li Y, Luo J and Chen Z. Risk factors of persistent cesarean scar pregnancy after dilation and curettage: a matched case-control study. Taiwan J Obstet Gynecol 2020; 59: 237-242.

[7] Zutt M, Emmert S, Hanssle H, Grafe A, Domhof S, Neumann C and Kretschmer L. Improved scar formation after using a medical surgical zipper for wound closure under tension. Hautarzt 2003; 54: 342-347.

[8] Chen H, Pan W, Zhang J, Cheng H and Tan Q. The application of W-plasty combined Botox-A injection in treating sunk scar on the face. Medicine (Baltimore) 2018; 97: e11427.

[9] Harn HI, Ogawa R, Hsu CK, Hughes MW, Tang MJ and Chuong CM. The tension biology of wound healing. Exp Dermatol 2019; 28: 464-471.

[10] Butzelaar L, Ulrich MM, Mink van der Molen AB, Niessen FB and Beelen RH. Currently known risk factors for hypertrophic skin scarring: a review. J Plast Reconstr Aesthet Surg 2016; 69: 163-169.

[11] Agarwal S, D'Souza R, Ryu M and Maxwell C. Barbed vs conventional suture at cesarean delivery: a systematic review and meta-analysis. Acta Obstet Gynecol Scand 2021; 100: 1010-1018.

[12] Liu Z, Tang Z, Hao X, Liu X, He L, Yu X, Wang R, He Y, Guo Y and Shu M. Modified buried vertical mattress suture versus buried intradermal suture: a prospective split-scar study. Dermatol Surg 2021; 47: e75-e80.

[13] Andrachuk J and Yang SS. Modified total trapezial and partial trapezoidal excision and ligament reconstruction tendon interposition reduces symptoms in isolated scaphotrapezial-trapezoid arthritis of the wrist. J Hand Surg Eur Vol 2012; 37: 637-641.

[14] Faiz KW. VAS--visual analog scale. Tidsskr Nor Laegeforen 2014; 134: 323.

[15] Tyack Z, Simons M, Spinks A and Wasiak J. A systematic review of the quality of burn scar rating scales for clinical and research use. Burns 2012; 38: 6-18.

[16] Toriseva M, Laato M, Carpen O, Ruohonen ST, Savontaus E, Inada M, Krane SM and Kahari VM. MMP-13 regulates growth of wound granulation tissue and modulates gene expression signatures involved in inflammation, proteolysis, and cell viability. PLoS One 2012; 7: e42596.

[17] Kim JM, Choo JE, Lee HJ, Kim KN and Chang SE. Epidermal growth factor attenuated the expression of inflammatory cytokines in human epidermal keratinocyte exposed to propionibacterium acnes. Ann Dermatol 2018; 30: 54-63.

[18] Timor-Tritsch IE, Monteagudo A, Cali G, D'Antonio F and Kaelin Agten A. Cesarean scar pregnancy: diagnosis and pathogenesis. Obstet Gynecol Clin North Am 2019; 46: 797-811.
[19] Schrufer-Poland TL, Ruiz MP, Kassar S, Tomassian C, Algren SD and Yeast JD. Incidence of wound complications in cesarean deliveries following closure with absorbable subcuticular staples versus conventional skin closure techniques. Eur J Obstet Gynecol Reprod Biol 2016; 206: 53-56.
[20] Sadick NS, D'Amelio DL and Weinstein C. The modified buried vertical mattress suture. A new technique of buried absorbable wound closure associated with excellent cosmesis for wounds under tension. J Dermatol Surg Oncol 1994; 20: 735-739.
[21] Meng F, Andrea S, Cheng S, Wang Q and Huo R. Modified subcutaneous buried horizontal mattress suture compared with vertical buried mattress suture. Ann Plast Surg 2017; 79: 197-202.
[22] Hohenleutner U, Egner N, Hohenleutner S and Landthaler M. Intradermal buried vertical mattress suture as sole skin closure: evaluation of 149 cases. Acta Derm Venereol 2000; 80: 344-347.
[23] Lee HJ and Jang YJ. Recent understandings of biology, prophylaxis and treatment strategies for hypertrophic scars and keloids. Int J Mol Sci 2018; 19: 711.
[24] Wang CB, Chiu WW, Lee CY, Sun YL, Lin YH and Tseng CJ. Cesarean scar defect: correlation between Cesarean section number, defect size, clinical symptoms and uterine position. Ultrasound Obstet Gynecol 2009; 34: 85-89.
[25] Zhang X, Diao JS, Guo SZ, Han Y, Ai YF, Zeng XH, Li LW and Shu MG. Wedge-shaped excision and modified vertical mattress suture fully buried in a multilayered and tensioned wound closure. Aesthetic Plast Surg 2009; 33: 457-460.