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Metroplasty in the delivery of pregnant women with a history of two cesarean sections

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ABSTRACT

AIM: This study aimed to evaluate the effectiveness of metroplasty at the stage of abdominal delivery in women who had undergone two cesarean section operations.

MATERIALS AND METHODS: Between 2020 and 2022, 150 pregnant women were examined. The patients were divided into three groups: the first group included pregnant women who had undergone one cesarean section, and the second group included those with two operations. In these groups, metroplasty was performed at the stage of delivery. The third group (control group) included pregnant women with a history of two cesarean sections who underwent surgical delivery without excision of the scar tissue in the lower segment. Metroplasty was performed before fetal retrieval with the whole fetal bladder in accordance with the patent "method of metroplasty during operative delivery in women with two or more cesarean sections." To assess the dynamics of changes in scar thickness, all women underwent ultrasound examination 2 h, 3 days, and 6 months after delivery.

RESULTS: Resection of the scar area on the uterus during repeated cesarean sections improved the residual thickness of the myometrium, which was determined by ultrasound examination 6 months after the operation.

CONCLUSION: The proposed technique allows the formation of a functionally sound scar on the uterus after two cesarean sections.

Keywords: cesarean section; scar "niche"; uterine scar; metroplasty; uterine scar failure.

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Опыт метропластики на этапе родоразрешения у беременных с двумя операциями кесарева сечения в анамнезе

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АННОТАЦИЯ

Цель. Оценить эффективность метропластики на этапе абдоминального родоразрешения у женщин с двумя операциями кесарева сечения в анамнезе.

Материалы и методы. В 2020–2022 гг. обследовано 150 беременных женщин. Пациентки были разделены на 3 группы: первая группа — беременные с одной операцией кесарева сечения в анамнезе, вторая группа — с двумя операциями. В этих группах на этапе родоразрешения проводили метропластику. Третья группа (контрольная) — беременные с двумя операциями кесарева сечения в анамнезе, которым оперативное родоразрешение было проведено без иссечения рубцовой ткани в области нижнего сегмента. Метропластику выполняли до извлечения плода при целом плодном пузыре в соответствии с патентом «Способ метропластики во время оперативного родоразрешения у женщин с двумя и более операциями кесарева сечения». С целью изучения динамики изменения толщины рубца всем женщинам провели ультразвуковое исследование через 2 ч, на 3-и сут после родоразрешения и через 6 мес. после родов.

Результаты. Резекция области рубца на матке во время повторного кесарева сечения улучшает показатели остаточной толщины миометрия, что определяется при ультразвуковом исследовании через 6 мес. после операции.

Заключение. Данная методика позволяет сформировать функционально состоятельный рубец на матке после двух операций кесарева сечения.

Ключевые слова: кесарево сечение; «ниша» рубца; рубец на матке; метропластика; несостоятельность рубца на матке.

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对有过两次剖腹产史的孕妇在分娩阶段进行产道成形术的经验

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摘要

目标。 本研究的目的是评估对有过两次剖腹产史的产妇在腹部分娩阶段进行子宫成形术的疗效。

材料与方法。 2020–2022年，对150名孕妇进行了检查。患者被分为三组：第一组包括有过一次剖腹产手术史的孕妇，第二组包括有过两次手术史的孕妇。在这些组别中，都是在分娩阶段进行了子宫成形术。第三组（对照组）是有两次剖腹产史的孕妇，她们在没有切除下段瘢痕组织的情况下进行了手术分娩。根据专利“两次或两次以上剖腹产妇女在手术分娩过程中进行子宫成形术的方法”，在胎儿取出前进行了子宫成形术，胎儿膀胱完好无损。为了研究瘢痕厚度的动态变化，所有产妇分别在产后第三天和产后6个月接受了2小时的超声检查。

结果。 在再次剖腹产手术中切除子宫瘢痕区域可改善子宫内膜残余厚度，这是在术后6个月超声检查中确定的。

结论。 这项技术可以在两次剖腹产后在子宫上形成功能完整的瘢痕。

关键词： 剖腹产；瘢痕；子宫疤痕；子宫成形术；子宫疤痕不愈合。

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INTRODUCTION

In recent decades, the World Health Organization (WHO) states that the increasing number of cesarean sections (CS) does not improve perinatal outcomes, but approximately one in four women undergoes operative delivery [1, 2]. A specific aspect of modern obstetrics is the increase in the number of repeated CS, with a uterine scar being the cause of indication for CS in more than 70% of cases [3]. Uterine scarring after a CS significantly complicates the choice of the management strategy for subsequent delivery [4, 5]. Currently, a uterine scar is not considered an absolute indication for repeat abdominal delivery. According to statistics from different countries, from 13% to 30–50% of patients with a uterine scar can be selected for vaginal delivery, but despite this, the frequency of vaginal delivery in patients with a uterine scar in the Russian Federation does not exceed 1.5% [6]. Thus, the number of women with two or more uterine scars is increasing. There are 10% to 13% of these women today [6]. In turn, the “epidemic” of CS causes an increase in the number of distant complications after this surgery [7, 8]. Maternal morbidity in repeat surgery is 3–4 times higher than in vaginal delivery [9]. The risk of uterine rupture increases with an increasing defect size and becomes higher at any scar thickness of not more than 5 mm [10]. Abnormal placental implantation increases in proportion to the number of performed CSs [11]. Repeat CS, let alone a third or fourth surgery, is associated with a 1.5- and 2.3-fold increase in the risk of intra- and postoperative complications, respectively [12]. Patients with two or more uterine scars after CS are at risk of forming an insufficient scar in the late postoperative period [13], requiring surgical correction, i.e., metroplasty, which involves excision of pathologic tissues in the area of the postoperative scar after CS and formation of a new full-fledged suture [14, 15]. In recent years, a number of scientific papers by Russian and foreign authors have been published on pregravid metroplasty with abdominal, endoscopic (traditional laparoscopic, robot-assisted, hysteroscopic) or vaginal approach. This reconstruction technique is the most widespread and recognized one in the world [16, 17]. However, it should be remembered that metroplasty is an additional surgery, which carries a risk of surgical and anesthetic complications. In CS, metroplasty is most often performed during organ-preserving surgeries for placental ingrowth [18–20]. However, to date, the issue of reconstructive surgery during a repeat CS, when entry into the abdominal cavity shows a disrupted integrity of the uterine wall, scar thinning and gross changes, remains open. Studies on this issue are ongoing [21].

The study was aimed at evaluating the efficacy of metroplasty at the abdominal delivery in women with a history of two CSs.

MATERIALS AND METHODS

Between 2020 and 2022, 150 pregnant women aged 23 to 37 years were examined. The patients were divided into three groups of 50 participants according to the study purposes: Group 1 included pregnant women with a history of one CS, Group 2 included pregnant women with two CSs. In these groups, metroplasty was performed at the delivery stage. Group 3 (control) included pregnant women with a history of two CSs who underwent surgical delivery without excision of scar tissue in the lower segment.

Inclusion criteria: a history of CS with two uterine scars, categorical refusal of vaginal delivery by pregnant women with one uterine scar, even in the favorable conditions, mature gestational age, singleton pregnancy, cephalic presentation, transverse uterine incision, elective delivery, placenta localization outside the uterine scar.

Exclusion criteria: placenta invasion abnormalities, placenta previa, multiple pregnancy, pelvic presentation, gestational age of less than 37 weeks, uterine scar after previous reconstructive uterine surgeries, uterine angle resection, rudimentary uterine horn, myomectomy.

The study protocol was approved by the local ethical committee of the Bashkir State Medical University of the Ministry of Health of Russia (Extract from Minutes of the Meeting No. 11 dated November 17, 2021).

All pregnant women who were included in the study delivered in the maternity department of the clinic of the Bashkir State Medical University of the Federal State Budgetary Educational Institution of the Ministry of Health of the Russian Federation (Ufa) electively at a mature gestational age under spinal anesthesia. The maximum time from the surgery onset to fetus retrieval was 7–8 min, which had no effect on perinatal outcomes.

All pregnant women underwent transabdominal ultrasound (TUS) on Voluson 10 to evaluate the scar one hour before elective surgical delivery.

In the first two study groups, CS and excision of scar tissue were performed according to our technique “Method of Metroplasty during Operative Delivery in Women with Two or More Cesarean Sections” [22].

The main steps of CS using the proposed metroplasty method were as follows:

- 1) laparotomy with excision of the skin scar on the anterior abdominal wall;
- 2) wide opening of the peritoneum of the vesicouterine pouch;
- 3) mobilization of the lower uterine segment and bladder by acute dissection with careful ligation and coagulation of the vessels between the uterus and bladder until complete visualization of healthy tissues on the anterior uterine wall;
- 4) determination of the level of uterine transverse incision along the upper border of the altered scarred myometrium

and transverse incision of myometrium up to 1.5–2 cm long to the fetal bladder;

5) metroplasty for whole fetal bladder without opening the fetal membranes;

6) acute capito-caudal dilatation of the myometrium by 5–7 cm controlled by the left hand fingers inserted between the fetal membranes and the uterine wall;

7) the lower uterine incision was taken along the edges on bullet forceps, followed by excision of the altered myometrium within healthy tissues;

8) blunt or acute dilatation of the fetal membranes, fetal delivery;

9) uterus exteriorization before the placenta removal, followed by the placenta removal;

10) suturing of the resected myometrium with separate knotted sutures using synthetic absorbable threads, achievement of complete hemostasis;

11) peritonization of the uterine incision with visceral peritoneum without myometrium grasping;

12) layer-by-layer suturing of the anterior abdominal wall.

The material resected during surgery was sent for histological examination. Tissues of the lower uterine segment were sampled for the study during CS by scar excision according to the technique described above with the whole fetal bladder before fetus retrieval; tissue fragments were fixed in 10% formalin. The obtained histological sample was stained with hematoxylin-eosin. Microscopy was used to evaluate the scar structure: the ratio of connective and smooth muscle tissue, the presence of adipose tissue, the severity of vascularization and inflammatory infiltration in the scar area.

To study changes in scar thickness over time, ultrasound was performed in the early postpartum period, on Day 3 after delivery and 6 months later.

Mathematical and statistical data processing was performed using Statistica 10 software. Since the used data could not be considered as a modification of normal distribution by the Kolmogorov–Smirnov test, nonparametric tests that were distribution-free and resistant to artifacts and sample sizes were used for the analysis, i.e. analysis of variance for independent or dependent samples using Kruskal–Wallis or Friedman test and comparison of individual groups using Mann–Whitney or Wilcoxon test. Accordingly, medians (Me) and quartiles (Q1 and Q3) were used to describe the results.

RESULTS

The mean age of the pregnant women was 29.0 ± 5.7 years in the group with one CS and metroplasty, 31.9 ± 3.2 years in the group with two CSs and metroplasty, and 32.8 ± 3.5 years in the control group with two CSs without metroplasty.

When assessing the thickness of the uterine scar before surgical delivery using transabdominal ultrasound, significant differences were found depending on the patients' belonging to three study groups: $\chi^2=43.7$, $p < 0.0001$.

Figure 1 shows that the greatest scar thickness was in the patients of Group 1: Me=1.45 mm (Q1=1.4 mm, Q3=1.6 mm). These values were significantly higher ($p < 0.0001$) than in the second (Me=1.3 mm; Q1=1.2 mm, Q3=1.4 mm) and third (Me=1.3 mm; Q1=1.2 mm, Q3=1.4 mm) study groups. Along with this, the scar thicknesses in Group 2 and Group 3 were very similar and, respectively, were not significantly different ($p > 0.13$). That is, the uterine scar thickness differed significantly depending on the number of previous CSs: it was minimal in patients with a history of two CSs and maximal after one CS.

According to the literature, the predominance of muscle tissue over connective tissue is considered to be one of the criteria of uterine scar sufficiency. The signs of morphologically incomplete scar include foci of connective tissue disorganization. An incomplete scar is also characterized by large foci of immature connective tissue and decreased muscle density [23].

In this study, histological assessment of the scar determined not only the ratio of muscle and connective tissue in the excised scar tissue, but also the quality of vascularization. Histological examination revealed significant differences in the scar structure in the patients of Group 1 and Group 2 after metroplasty during abdominal delivery using the technique described above. The scar structure of the patients in Group 1 (with one uterine scar) mostly contained muscle fibers, the scar tissue was well vascularized. In Group 2 (with two uterine scars), the boundary between muscle and connective tissue was clearly visible in the excised tissue structure. The connective tissue mostly contained teased muscle fibers; the tissue was hypovascular.

The proportion of muscle tissue in the scar was also significantly dependent on the patients' belonging to groups with different numbers of CSs: $\chi^2=18.5$, $p < 0.0002$. The highest proportion of muscle tissue in the scar (Me=75%, Q1=50%, Q2=75%) was in Group 1. This value was significantly ($p < 0.002$ and $p < 0.0001$, respectively) higher than in Group 2 using the Mann–Whitney test. The amount of connective tissue in the groups with one and two CSs was inversely proportional to the amount of muscle tissue. The

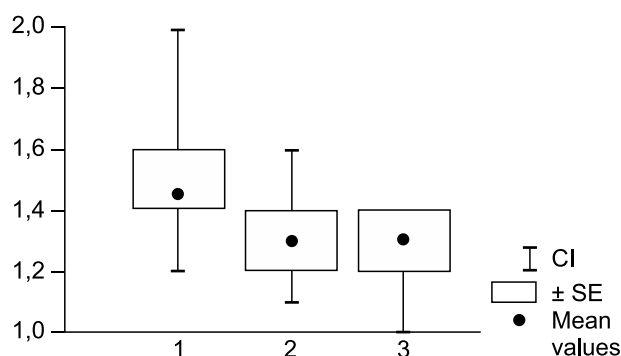


Fig. 1. Scar thickness before delivery in three groups: the abscissa axis shows the numbers of the groups: 1, one CS with metroplasty; 2, two CSs and metroplasty; 3, two CSs without metroplasty (control). On the ordinate axis, the scar thickness in mm.

lowest amount of connective tissue was in Group 1, $Me=25\%$ ($Q1=25\%$, $Q3=50\%$) versus $Me=50\%$ ($Q1=50\%$, $Q3=75\%$) in Group 2. It should also be noted that in Group 1 (one CS) there were cases with up to 100% of muscle tissue in the scar and 0% of connective tissue.

Further monitoring of the uterine scar was performed by dynamic ultrasound of myometrial thickness in the area of the postoperative scar 2 hours after abdominal surgical delivery, on Day 3 and in 6 months in patients of all three study groups.

The dependence of scar thickness on time since CS was significant in all three groups: $\chi^2=35.6$, $p < 0.0001$; $\chi^2=50.0$, $p < 0.0001$; $\chi^2=40.6$, $p < 0.0001$, respectively. Figure 2 shows that this dependence was demonstrated as a consistent decrease in scar thickness. In Group 1, the median scar thickness was 9 mm ($Q1=8$ mm, $Q3=11$ mm) 2 h

after the surgery, 9 mm ($Q1=8$ mm, $Q3=9$ mm) three days later, and 7 mm ($Q1=7$ mm, $Q3=8$ mm) six months later. In Group 2 at the same time points, these values were 8 mm ($Q1=8$ mm, $Q3=9$ mm), 8 mm ($Q1=7$ mm, $Q3=8$ mm) and 7 mm ($Q1=7$ mm, $Q3=7$ mm); and in the third group, they were 6.5 mm ($Q1=5$ mm, $Q3=7$ mm), 6 mm ($Q1=5$ mm, $Q3=6$ mm), and 5 mm ($Q1=7$ mm, $Q3=7$ mm), respectively.

Moreover, Figure 2 shows that 2 h after the surgery, the differences in scar thickness in patients of Group 1 and Group 2 were obvious and significant ($p < 0.001$), and by the end of the follow-up period, the values were not significantly different ($p > 0.06$).

Changes in scar thickness over time in Group 3 at all follow-up steps were significantly ($p < 0.0001$) lower than in Group 1 and Group 2. Importantly, in 12% of patients (6 cases) in this group after 6 months, ultrasound revealed a local recess-type myometrial thinning; subsequently, these patients required surgery of the scar outside of pregnancy. In the first two groups, no signs of local myometrial thinning in the scar area were found during this period.

The data on blood loss during CS appeared to be a modification of normal distribution by the Kolmogorov–Smirnov test, which allowed parametric Fisher's analysis of variance to be applied to them. The level of blood loss was significantly dependent on the patients' belonging to groups with different number of CS and presence or absence of metroplasty: $\eta=0.21$, $F=3.5$, $p < 0.04$. Figure 3 shows that the lowest mean level of blood loss was in Group 1, i.e., 521.5 ± 57.2 mm³. This value was significantly ($p < 0.03$ and $p < 0.02$, respectively) lower than in Group 2 and Group 3, 553.2 ± 76.2 mm³ and 555.5 ± 81.4 mm³, respectively. At the same time, the mean levels of blood loss were not just quite similar, but were not significantly different in Group 2 and Group 3 ($p > 0.86$). In other words, CS performed using the proposed technique in women with two uterine scars with metroplasty as an additional surgery step did not increase intraoperative blood loss.

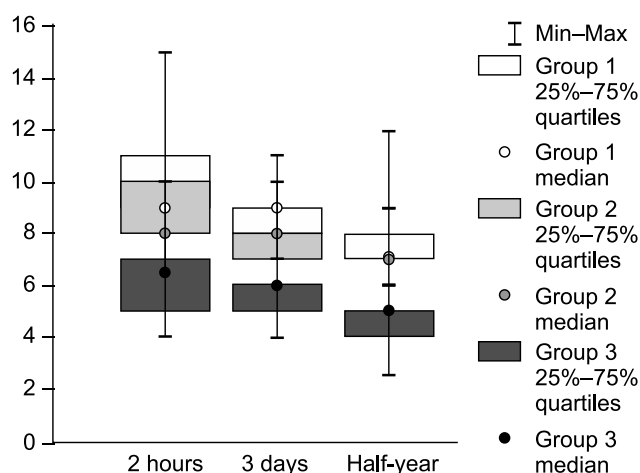


Fig. 2. Sequential changes in the scar thickness at different terms after CS in patients with one CS and metroplasty (group 1), with two CSs and metroplasty (group 2), and with two CSs without metroplasty (group 3, control). On the ordinate axis, scar thickness in mm.

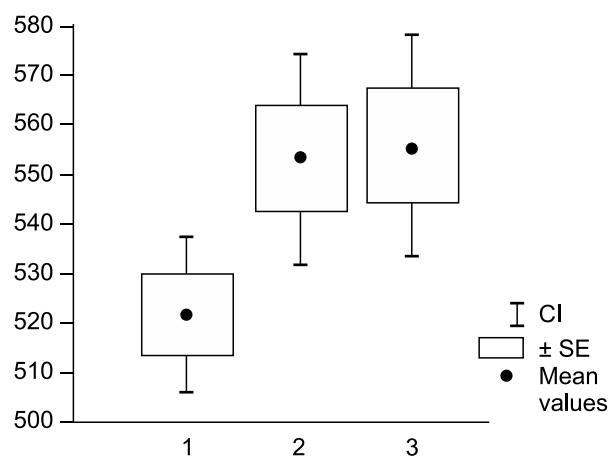


Fig. 3. Mean blood loss in the three groups: the abscissa axis shows the group numbers: 1, one CS with metroplasty; 2, two CSs and metroplasty; and 3, two CSs without metroplasty (control). The ordinate axis presents the blood loss in mm³. CI, confidence interval; SE, standard errors of mean values.

DISCUSSION

The persisting high incidence of CS is of global concern. The number of women with two or more uterine scars is increasing. The main danger related to the delivery in such women is the formation of an insufficient uterine scar. Taking into account the above, in recent years the issue of reconstructive surgery (metroplasty) during repeat CSs has become more urgent, since it will allow preserving the woman's reproductive function subsequently and performing the fourth and fifth CS without risks of scar insufficiency, uterine rupture, placenta previa, and placenta ingrowth during pregnancy.

The analysis of the study in women with a history of one and two CSs showed that the myometrial thickness in the presumed scar area before delivery according to ultrasound significantly depended on the patients' belonging to the study groups. The lowest myometrial thickness was in the group

of women with a history of two CSs. The scar structure after one and two CSs was also different. According to the morphological analysis of excised scar tissue, muscle fibers prevailed in the scar structure in patients with a single uterine scar, and the tissue was well vascularized. The structure of the excised tissue in the group with two scars clearly showed the boundary between muscle and connective tissues. The connective tissue mostly contained teased muscle fibers; the tissue was hypovascular.

Significant quantitative differences in myometrial thickness in the study groups according to ultrasound, as well as data on the qualitative difference between one and two uterine scars, confirmed by histological examination, demonstrate that pregnant women undergoing repeated CS should undergo elective metroplasty at the delivery in order to form a sufficient uterine scar in the future.

During metroplasty performed using the proposed technique (before fetus retrieval, with the whole fetal bladder), the boundaries between healthy and scar tissue were more clearly visualized, thus enabling complete scar excision and achieving uniform thickness of the lower and upper edges of the incision. When suturing the uterine incision, the tissues were matched edge-to-edge with separate sutures; no additional myometrial ischemization occurred. In the postoperative period in such patients, the lower uterine segment contracted better, thus reducing the risk of postoperative complications. Assessment of the scar 6 months after the surgery demonstrated the high efficiency of the proposed surgical treatment: the myometrial thickness according to ultrasound in the new scar area averaged 7 mm in the groups where metroplasty was performed. None of the cases showed signs of localized myometrium thinning in the scar area during this period.

It is noteworthy that CS performed using the proposed technique in women with two uterine scars with metroplasty

as an additional surgery step did not increase intraoperative blood loss.

CONCLUSIONS

1. Resection of the uterine scar area during repeat CS improves residual myometrial thickness as determined by ultrasound 6 months after the surgery. This technique allows the formation of a functionally sufficient uterine scar after two CSs.

2. Metroplasty during the delivery has the potential benefit of reducing the risk of a recess formation and associated complications of scar insufficiency or abnormal implantation.

3. Abdominal delivery according to the proposed technique in pregnant women with a history of two CSs willing to preserve their reproductive potential allows for a sufficient uterine scar with one surgery, thereby reducing the percentage of scar surgeries in the subsequent pregravid stage.

4. Metroplasty at the abdominal delivery step does not increase intraoperative blood loss.

ADDITIONAL INFO

Authors' contribution. All authors confirm that their authorship meets the international ICMJE criteria (all authors made a substantial contribution to the conception of the work, acquisition, analysis, interpretation of data for the work, drafting and revising the work, final approval of the version to be published and agree to be accountable for all aspects of the work).

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Consent for publication. The patients who participated in the study signed an informed consent to participate in the study and publish medical data.

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