

Myorrhaphy surgical techniques

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ABSTRACT

Although vaginal birth is currently encouraged after a previous cesarean section, the rate of cesarean section has steadily increased in the last 10 years from 5% to 30-32%. As the rates of cesarean section increase, the rates of pathologies associated with uterine scarring increase, as for example pregnancy implanted at the level of the scar or various forms of invasive placenta. Using the search engines of the online libraries such as PubMed, Medscape, UpToDate, Cochrane, we selected studies on the surgical technique used in the caesarean section. For this paper, 8 scientific articles were selected considering both original articles and meta-analyses, cumulating a total of 9675 patients distributed into two categories, namely single and double layer. Double-layer suture of the uterine incision is preferred over single-layer suture, but both meet medical standards. At present, the benefits of one technique compared to the other (single layer/ double layer) are not unanimously demonstrated; multiple variables must be considered such as the actual technique in making the layers, type of suture used (continuous interlocking or non-interlocking or separate sutures) and the obstetrician's experience.

Keywords: suturing technique, remaining myometrium, single-layer suture, double-layer suture

INTRODUCTION

In today's obstetrics, cesarean delivery is reported in one in three women in the United States, and even four in five women in other parts of the world. Until the end of the 19th century, cesarean section was avoided due to the high mortality rate. With the description in 1926 by obstetrician John Martin Munro Kerr of the transverse incision in the uterine segment and the practice of double-layer myorrhaphy at this level, the maternal mortality rate decreased to 1% in most US hospitals. Although vagi-

nal delivery is currently encouraged after a previous cesarean section, the rate of cesarean section has steadily increased in the last 10 years from 5% to 30-32% [1].

As the rates of cesarean section increase, the rates of pathologies associated with uterine scarring increase, as for example, pregnancy implanted at the level of the scar or various forms of invasive placenta. In this context, we consider the need for a more efficient myorrhaphy that meets the necessary requirements, namely to ensure an efficient

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hemostasis and minimal negative effects on the remaining myometrium. It is thought that the suturing technique can be considered as an independent factor in the appearance of the uterine niche and thus in the appearance of the underlying pathology [2].

In order to shorten the operative time, most Dutch obstetricians use a continuous interlocking suture in a single layer for myorrhaphy during a caesarean section with the risk of developing a thinner remaining myometrium [3]. In this context, using the double-layer suture, especially with continuous interlocking suture, the thickness of the resulting remaining myometrium appears to be larger. However, the prevalence of uterine rupture after the two techniques described above seems to be similar. At present, extensive randomized studies on the evaluation of suturing techniques on the development of the uterine niche after cesarean section, as well as subsequent gynecological and obstetric pathologies are not available [3].

Worldwide, the suturing technique used in caesarean section differs between different centers, each with its own advantages and disadvantages. Suturing techniques include: continuous interlocking suture or non-interlocking in a single layer, continuous interlocking suture, or non-interlocking in a double layer, separated suture in one or two layers. In the above-mentioned information, the inclusion of the decidua in the suture can be considered or not. This article aims to provide a brief review of literature on current techniques used in caesarean section myorrhaphy as well as the associated short- and long-term effects.

MATERIALS AND METHODS

Using the search engines of PubMed, Medscape, UpToDate and Cochrane online libraries, we selected studies on the surgical technique used in postoperative caesarean section myorrhaphy. The variables sought and covering the field of interest included: “suturing technique”, “myorrhaphy”, “caesarean section”, “remaining myometrium”. The articles used in this paper have been impact studies published in the last 20 years. The information was centralized and correlations were formulated between the data currently existing in literature.

RESULTS

For this paper, 8 scientific articles were selected considering both original articles and meta-analyses, cumulating a total of 9,675 patients distributed into two categories, namely single- and double layer (Table 1). Thus, a much more extensive use of the technique can be found using continuous suture, ei-

ther interlocking or non-interlocking compared to separate sutures.

In the first meta-analysis, statistical heterogeneity was low among the presented studies. In the case of single-layer patients compared to double-layer patients, a similar incidence of scarring defects was found, but the thickness of the remaining myometrium on ultrasound was significantly smaller [4].

Some prospective studies using transvaginal ultrasonography as a method of evaluating the uterine scar, recommend the use of non-interlocking suture with the protection of the decidua to achieve an optimization regarding the alignment of the myometrial layers as well as their regeneration. The lack of statistical significance prevents the reaching of a definitive conclusion. However, in the case of using the double-layer technique with continuous non-interlocking suture, including the decidua in the suture, the thickness of the associated remaining myometrium is higher [5].

DISCUSSIONS

Some authors showed their preference for double-layer closure, in the entire uterine thickness, with the help of a slowly resorbable synthetic suture [12]. The first suture layer includes the myometrium and endometrium, the purpose being hemostasis, and the second suture layer covers the exposed myometrial edges. The inclusion of endometrial decidua in the suture is recommended based on a randomized study [13], which concluded that full-thickness uterine suturing is less commonly associated with incomplete healing than partial suturing (44.7% versus 68.8%). Thus, the inclusion of the endometrium is an important determinant of scar healing. This hypothesis is inconsistent with the previous recommendations according to which the inclusion of the decidua favors the appearance of endometriotic implants, which leaves the decision to the discretion of the operator.

In choosing the type of needle used, either blunt-tip or sharp-tip needles, it may be considered that, although sharp-tip needles have better surgical performance, being easier to use due to easier penetration through tissues, blunt-tip ones are safer for the surgeon if the perforation rate of the gloves is analyzed [14]. Regarding the suture materials used, there are no statistically significant differences regarding the consequences of the use of certain suture materials on the healing quality [12].

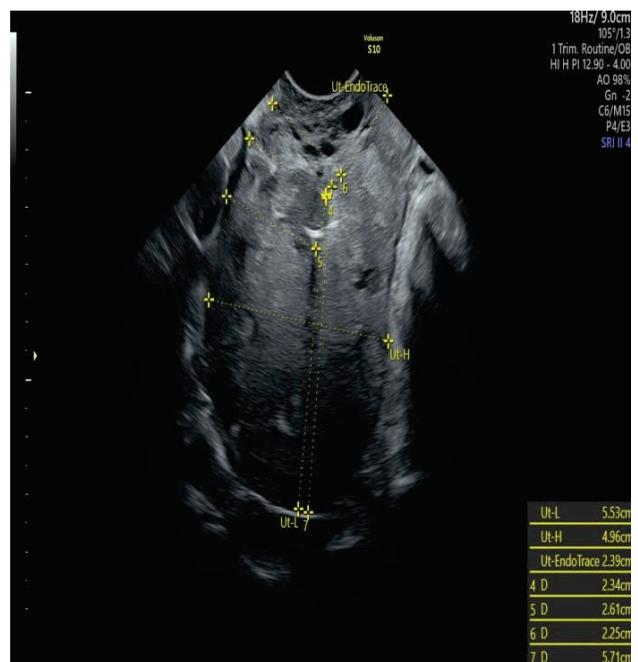
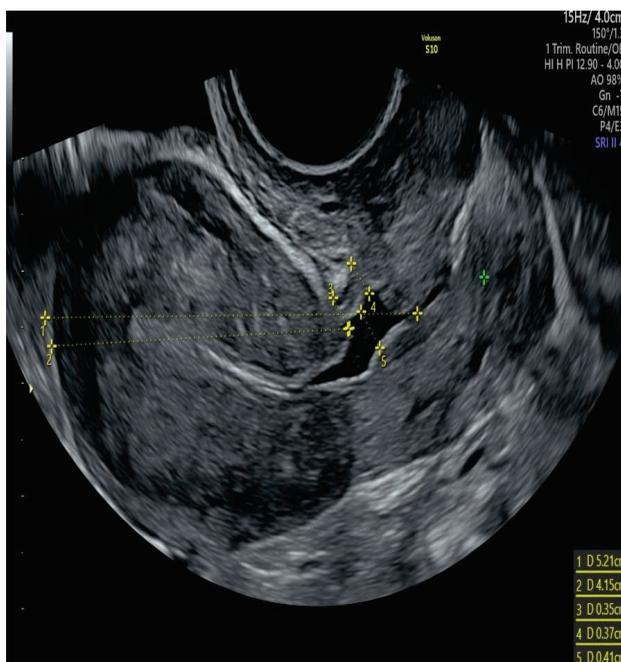
Double-layer suture is preferred over single-layer suture, but both meet medical standards. In the case of using the single layer, the technique is performed 6.1 minutes faster, being preferred, for example, when performing concomitant tubal sterilization that ensures the absence of future exposure

TABLE 1. Summary table of selected studies including number of patients, type of suture and prognostic results

Authors	No. of patients	Suture type	Expected outcome
Di Spiezio Sardo et al. [4]	3696	Single layer (any type) and double layer (any type)	Similar incidence for scarring defect, uterine dehiscence as well as uterine rupture in a subsequent pregnancy regardless of the number of layers.
Hanacek et al. [5]	324	Single layer (46%) (continuous non-interlocking including the decidua) and double layer (54%) (continuous non-interlocking including the decidua)	The use of a double layer suture is associated with a greater thickness of the remaining myometrium. The type of suture used does not have a significant impact on the thickness of the segment.
Vachon-Marceau et al. [6]	1613	Single layer (31%) (continuous non-interlocking including the decidua) and double layer (69%)	The use of the double layer suture is associated with a greater thickness of the segment in the 3rd trimester of a subsequent pregnancy.
Kataoka et al. [7]	267	Single layer (21,7%) (separate sutures including the decidua) and double layer (78,3%) (separate sutures including the decidua)	The use of a single layer suture may be associated with larger scar niches but is not associated with the frequency of niche occurrence.
Bamberg et al. [8]	435	Single layer (34,4% continuous non-interlocking suture and 36% continuous interlocking suture) and double layer (29,6% continuous non-interlocking suture)	The use of a double-layer suture is associated with a thicker myometrial scar only in primiparous or elective caesarean sections.
Nur Betül Tekiner et al. [9]	280	Single layer (45%) and double layer (55%)	The number of layers does not seem to be a determining factor in the size of the scarring defect at the saline ultrasound uterine scan at 3 months.
Stegwee et al. [10]	2292	Single layer (50%) (continuous non-interlocking suture) and double layer (50%) (continuous non-interlocking suture)	None of the sutures showed superiority in postmenstrual spotting after the first cesarean section.
Durnwald et al. [11]	768	Single layer (34,7%) and double layer (65,3%)	There is an association between the use of the single layer technique and the decrease of the infectious morbidity index.

of the scar to the distension after a new pregnancy; however, it should not be forgotten that the presence of the niche is the cause of abnormal uterine or intermenstrual bleeding in women of reproduc-

tive age. In the short term, there are no differences in the rates of complications associated with the two techniques (single or double layer): wound infections, maternal infectious morbidity, endometri-



a) Single-layer interrupted suture

b) Double-layer interrupted suture

FIGURE 1. Ultrasound image six weeks after cesarean section in which single-layer and double-layer interrupted suture was performed

tis, bleeding, the need for transfusion, and period of hospitalization [15].

In the long run, on the other hand, single-layer suturing theoretically has a higher risk of uterine rupture. A systematic review published in 2017 [4] found similar incidences of scarring, uterine dehiscence, and rupture in subsequent pregnancies. However, on postpartum ultrasound, a lower remaining myometrium thickness was observed in the case of single-layer suture [4]. In addition, a secondary analysis of data from a prospective study of women who had repeated cesarean sections found an increased risk of bladder adhesions in single-layer sutures [16]. In a 2014 review [15], it was also observed that the single-layer suture as well as the one in which the first layer is made with interlocking suture is associated with a lower remaining myometrium thickness. Thus, in the case of a single-layer suture, an important role in the occurrence of complications could be played by the technique used. An important mention is that most studies focus on the comparison of single-layer versus double-layer. There is no accurate study that compares the surgical technique by continuous thread and interrupted thread. In Figure.1 are shown the adjacent and residual myometrial values after six weeks from the cesarean section in which single-layer and double-layer interrupted threads were used.

The interlocking suture technique is preferred because its use is associated with a more frequent occurrence of elements that indicate poor scarring (reduced myometrium thickness, uterine wall de-

fects in the shape of a “bell”), ruptures or uterine dehiscence. The probable explanation is that the non-interlocking suture has a less pronounced ischemic effect on uterine tissue [17]. A review of literature indicated that the risk of uterine rupture increases after a single-layer interlocking suture, but not after a non-interlocking one [18]. Bennich et al. [19] showed that by comparing the single layer with the double layer using continuous non-interlocking suture, the remaining myometrium thickness does not increase, thus suggesting that by double-layer suture no improvement in myometrium thickness is made in addition to the single-layer non-interlocking suture.

CONCLUSIONS

It can be concluded that although some studies show the usefulness of performing the double-layer suture for its association with a higher remaining myometrium thickness and a lower scarring defect, this fact is not demonstrated on a general scale; moreover, similar incidences are reported for the occurrence of scarring defects, uterine dehiscence and uterine rupture in a subsequent pregnancy regardless of the number of layers, the superiority of one technique over another being influenced by both the surgical experience and the obstetrician's technique, the use of continuous interlocking or non-interlocking suture, as well as the method of separate sutures in making layers.

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REFERENCES

1. Antoine C, Young BK. Cesarean section one hundred years 1920-2020: the Good, the Bad and the Ugly. *J Perinat Med.* 2020 Sep 4;49(1):5-16.
2. Bij de Vaate AJ, van der Voet LF, Naji O, Witmer M, Veersema S, Brölmann HA, Bourne T, Huirne JA. Prevalence, potential risk factors for development and symptoms related to the presence of uterine niches following Cesarean section: systematic review. *Ultrasound Obstet Gynecol.* 2014 Apr;43(4):372-82.
3. Stegwee SI, Jordans IPM, van der Voet LF, Bongers MY, et al. Single-versus double-layer closure of the caesarean (uterine) scar in the prevention of gynaecological symptoms in relation to niche development - the 2Close study: a multicentre randomised controlled trial. *BMC Pregnancy Childbirth.* 2019 Mar 4;19(1):85.
4. Di Spiezo Sardo A, Saccone G, McCurdy R, Bujold E, Bifulco G, Berghella V. Risk of Cesarean scar defect following single- vs double-layer uterine closure: systematic review and meta-analysis of randomized controlled trials. *Ultrasound Obstet Gynecol.* 2017 Nov;50(5):578-583.
5. Hanacek J, Vojtech J, Urbankova I, Krcmar M, Křepelka P, Feyereisl J, Krofta L. Ultrasound cesarean scar assessment one year postpartum in relation to one- or two-layer uterine suture closure. *Acta Obstet Gynecol Scand.* 2020 Jan;99(1):69-78.
6. Vachon-Marceau C, Demers S, Bujold E, Roberge S, et al. Single versus double-layer uterine closure at cesarean: impact on lower uterine segment thickness at next pregnancy. *Am J Obstet Gynecol.* 2017 Jul;217(1):65.e1-65.e5.
7. Kataoka S, Tanuma F, Iwaki Y, Iwaki K, Fujii T, Fujimoto T. Comparison of the primary cesarean hysterotomy scars after single- and double-layer interrupted closure. *Acta Obstet Gynecol Scand.* 2016 Dec; 95(12):1352-1358.
8. Bamberg C, Dudenhausen JW, Bujak V, Rodekamp E, et al. A Prospective Randomized Clinical Trial of Single vs. Double Layer Closure of Hysterotomy at the Time of Cesarean Delivery: The Effect on Uterine Scar Thickness. *Ultraschall Med.* 2018 Jun;39(3):343-351.
9. Tekiner NB, Çetin BA, Türkgeldi LS, Yılmaz G, Polat İ, Gedikbaşı A. Evaluation of cesarean scar after single- and double-layer hysterotomy closure: a prospective cross-sectional study. *Arch Gynecol Obstet.* 2018 May;297(5):1137-1143.
10. Stegwee SI, van der Voet LF, Ben AJ, de Leeuw RA, van de Ven PM, Duijnhoven RG, Bongers MY, Lambalk CB, de Groot C, Huirne J; 2Close study group. Effect of single- versus double-layer uterine closure during caesarean section on postmenstrual spotting (2Close): multicentre, double-blind, randomised controlled superiority trial. *BJOG.* 2021 Apr; 128(5):866-878.
11. Durnwald C, Mercer B. Uterine rupture, perioperative and perinatal morbidity after single-layer and double-layer closure at cesarean delivery. *Am J Obstet Gynecol.* 2003 Oct;189(4):925-9.
12. Carbone L, Saccone G, Conforti A, Maruotti GM, Berghella V. Cesarean delivery: an evidence-based review of the technique. *Minerva Obstet Gynecol.* 2021 Feb;73(1):57-66.

13. Yazicioglu F, Gökdoğan A, Kelekci S, Aygün M, Savan K. Incomplete healing of the uterine incision after caesarean section: Is it preventable? *Eur J Obstet Gynecol Reprod Biol.* 2006 Jan 1;124(1):32-6.
14. Parantainen A, Verbeek JH, Lavoie MC, Pahwa M. Blunt versus sharp suture needles for preventing percutaneous exposure incidents in surgical staff. *Cochrane Database Syst Rev.* 2011 Nov 9;2011(11):CD009170.
15. Roberge S, Demers S, Berghella V, Chaillet N, Moore L, Bujold E. Impact of single- vs double-layer closure on adverse outcomes and uterine scar defect: a systematic review and metaanalysis. *Am J Obstet Gynecol.* 2014 Nov;211(5):453-60.
16. Blumenfeld YJ, Caughey AB, El-Sayed YY, Daniels K, Lyell DJ. Single- versus double-layer hysterotomy closure at primary caesarean delivery and bladder adhesions. *BJOG.* 2010 May;117(6):690-4.
17. Ceci O, Cantatore C, Scioscia M, Nardelli C, Ravi M, Vimercati A, Bettocchi S. Ultrasonographic and hysteroscopic outcomes of uterine scar healing after cesarean section: comparison of two types of single-layer suture. *J Obstet Gynaecol Res.* 2012 Nov;38(11):1302-7.
18. Roberge S, Chaillet N, Boutin A, Moore L, Jastrow N, Brassard N, Gauthier RJ, Hudic I, Shipp TD, Weimar CH, Fatusic Z, Demers S, Bujold E. Single- versus double-layer closure of the hysterotomy incision during cesarean delivery and risk of uterine rupture. *Int J Gynaecol Obstet.* 2011 Oct;115(1):5-10.
19. Bennich G, Rudnicki M, Wilken-Jensen C, Lousen T, Lassen PD, Wøjdemann K. Impact of adding a second layer to a single unlocked closure of a Cesarean uterine incision: randomized controlled trial. *Ultrasound Obstet Gynecol.* 2016 Apr;47(4):417-22.