Minimal Invasive Management of Cesarean Scar Niche: Review Article

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Abstract:

Worldwide, rates of caesarean section are rising. The term 'niche' describes the presence of an hypoechoic area within the myometrium of the lower uterine segment, reflecting a discontinuation of the myometrium at the site of a previous caesarean section. A defect in caesarean section scar is associated with symptoms like abnormal uterine bleeding, infertility and complications in subsequent pregnancy including: risk of rupture and morbidly adherent placenta. It can also increase rates of complications during gynaecological procedures: IUCD insertion, evacuation of retained products of conception, hysteroscopy and risk of ectopic pregnancy at scar site.

Keywords: Niche, Hysteroscopic, laparoscopic.

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Introduction:

Cesarean sections have increased worldwide and there is an increasing awareness of the adverse long-term sequelae associated with the procedure. The World Health Organization estimates that there are approximately 18.5 million women who undergo this procedure annually, with rates in the Western world increasing from 14.5% to 27.2% between the years 2000 and 2017 **(1).**

A cesarean scar niche, first described in 1961 when a wedge-shaped defect was noted in the uterine wall of a patient who had previously had a cesarean section during hysterosalpingography**(2)**, is defined as the presence of a hypoechoic area and discontinuation of the myometrium at a previous lower-segment cesarean section scar site **(3).** Cesarean niche is also referred to as a cesarean scar defect, isthmocele, or a diverticulum. The presence of a cesarean scar niche is associated with gynecological symptoms such as abnormal uterine bleeding, dysmenorrhea, and subfertility, as well as potential adverse obstetrical outcomes resulting from cesarean scar pregnancy (CSP), uterine rupture, and placenta accreta spectrum (PAS) disorders **(4, 5).**

Symptoms related to menstrual bleeding should be managed medically in the first instance with usual hormone treatment, unless contemplating conception. The levonorgestrel intrauterine system (IUS) or endometrial ablation, with rollerball ablation to the niche cavity, is a less-invasive option in women without fertility requirements **(6).**

Typical surgical indications for minimally invasive niche surgery would include significant menstrual symptoms recalcitrant to medical treatment and/or subfertility suspected to relate to the presence of a caesarean niche (**7).**

Hysteroscopy

Hysteroscopic resection was first introduced in 1996 by **Fernandez et al. (8).** As known Hysteroscopy is the gold standard procedure for uterine cavity and cervical canal exploration and is the investigation of choice for AUB (**9).**

During the hysteroscopy, the isthmocele appears as a doming on the anterior wall of the cervical canal, easy to be localized on the isthmus site. Once diagnosed, an operative hysteroscopy can be performed to treat the defect, with a technique called isthmoplasty. According to the literature, the essential parameter to perform hysteroscopy is the residual myometrial thickness; indeed, with the hysteroscopic approach, there is a risk of bladder injury and uterine perforation if the myometrium thickness at the site of the defect is < 3 mm. Some authors suggest hysteroscopy to women with a residual myometrial thickness > 2 to 2.5 mm or with a scar defect size to myometrial thickness ratio < 50% and with no desire to get pregnant **(10-12).**

There is no homogeneous method to perform isthmoplasty, but almost every author uses a 9 mm resectoscope and unipolar electrical current. **Gubbini et al. (13)** performed a resection of the defect by removing the isthmocele edges and by putting its wall in continuity with the cervical canal wall.

The mean time for resectoscopic treatment varies from 8 to 25 minutes. **Gubbini et al. (14)** and **Florio et al. (15)** found an association between the duration of the isthmoplasty and the size of the niche.

The total amount of successful outcomes of isthmoplasty is 85.5% (59.6–100%). An evident attenuation of the symptoms was associated not only with the removal of the scar diverticulum, in which the menstrual blood tends to be retained, but also with the fulguration of dilated vessels that constitute a potential additional source of non-menstrual bleeding (11**).**

Good outcomes were also found regarding infertility: the majority of patients who desired to get pregnant conceived spontaneously between 12 and 24 months after the isthmoplasty **(15).**

According to **Zhang et al. (16)** the comparison between hysteroscopy and medical treatment, intrauterine device (IUD), laparoscopy, and vaginal repair showed that hysteroscopic surgery offered the advantages of shorter operation time, reduced blood loss, decreased length of hospital

stay, and lower hospital fees. However, one of the limitations of the resectoscopic treatment is the impossibility of the performance of sutures. This is why the scar defect could enlarge further, and the myometrial thickness at the level of the uterine isthmus could further decrease, increasing the risk of uterine rupture during future pregnancies.

In 2015, a Dutch, high-quality, multicentre, randomised control trial of hysteroscopic niche resection (HysNiche trial: Dutch Trial Register NTR3269) was established. The primary aim was to assess the impact of hysteroscopic resection on persistence of postmenstrual spotting. Participants were randomly assigned to hysteroscopic niche resection or expectant management. In all cases, patients underwent baseline evaluation by sonohysterography with re-evaluation at 6 months. Inclusion criteria were a sonohysterographically confirmed defect of at least 2 mm in depth associated with at least a residual myometrium of 3 mm or more. Significant improvements were reported in number of days of postmenstrual spotting (4 versus 7 days; P = 0.04) and in postmenstrual spotting-associated pain (P = 0.02) **(3).**

Proximal and Distal Correction vs Distal Correction Alone

Most surgeons carry out the procedure of a triangular resection with a resectoscope. This approach could theoretically eliminate symptoms more effectively than only distal correction but could potentially harm the internal os, which is usually difficult to locate. In 2009, **Chang et al. (11)** showed that resection of the cervical edge of the isthmocele is just as effective as resecting both edges without the risk of perforation or bladder injury .Following this technique, **Feng et al. (10)** and **Raimondo et al. (17)** obtained similar results.

Casadio et al. (18) published a case report on a new technique for hysteroscopic repair include channel like 360 degree ablation of the lower edge of the niche together with the opposite posterior endocervix using miniaturized hysteroscopy in 3 steps:

- **Step1**: resection of the posterior endocervix (allow paraphysiological creeping of the endocervical mucosa to cover the denuded surface)
- **Step 2**: resection of the lower edge of the niche
- **Step 3**: ball electrode coagulation of any remaining fibrosis and hemostasis

This technique is based on the rational that anterior inflamed niche will cause posterior wall inflammation.

Cohen et al. (19) studied repeated hysteroscopic resection of niche and found 8 patients underwent a second hysteroscopy after failure of the first hysteroscopy. Abnormal uterine bleeding (AUB) was the most common symptom, occurring in all patients. The average number of days of bleeding per cycle were significantly reduced following the second surgery [14.50 (range 8-21days) vs 11.75 (range 8-20days), respectively =0.009]. The second surgery improved symptoms in 6 out of the 8 patients with AUB and 1 of 2 patients with pain. There were no significant differences in

fertility and obstetric outcomes between the first and the second surgery and no complications were reported during any of the surgeries **(20).**

There is no doubt that laparoscopic repair increases the residual myometrial thickness, but there werelots of debate about the effect of hysteroscopy on RMT. **Tsuji et al. (21)** studied 18 patient. RMT was thicker after hysteroscopic surgery (median: 2.1 mm and 4.2 mm, before and after surgery, respectively; P = 0.0001). Isthmocele volume was significantly reduced after hysteroscopic surgery.

Regarding pregnancy outcome, **Tsuji et al. (21)** studied 38 women with secondary infertility due to Cesarean scar niche who underwent hysteroscopic surgery. Patients were followed up for 3 to 40 months after surgery. Surgery was successful in all cases and no complications were observed. Twenty-seven patients (71%) became pregnant (pregnant group), while 11 (29%) did not (non-pregnant group). Baseline characteristics of age, body mass index, gravidity, parity, previous cesarean section, presence of endometriosis, retroflex uterus, and preoperative residual myometrial thickness were not significantly different between the groups. However, the median residual myometrium thickness was significantly higher after surgery than before surgery in the pregnant group (1.9 [1.1-3.6] vs 4.9 [3.4-6.6] mm, P<0.0001), whereas this difference was not significant in the non-pregnant group. Of those who became pregnant, 85% conceived within 2 years of surgery. Although three pregnancies resulted in abortion 23 pregnancies resulted in healthy babies at 35-38 gestational weeks by scheduled cesarean sections with no obstetrical complications due to hysteroscopic surgery.

Vaginal Repair

Isthmocele vaginal repair has been evaluated by many authors **(20).**

After identifying the defect as a small hollow area or depression at the uterine isthmus, thanks also to the guidance of a probe in the uterus**,** a transverse incision was performed at the most prominent area of the bulge; afterwards, the isthmocele was removed, and the edges of the incision were trimmed to repair it. Then, the myometrial and vaginal defects were closed. The median operation time was 33.6 minutes. Clinical improvement was observed in between 85.9 and 92.9% of the patients: the prolonged menstrual symptoms were improved after the surgery, and a significant difference was found between the mean preoperative and postoperative menstruation length. Isthmocele transvaginal repair is comparably effective to the laparoscopic repair, but the surgical time is significantly shorter and the hospitalization expenses are lower.however vaginal surgery on undescendent uterus need special surgical skills and good instrumentation **(22).**

Laparoscopy

Laparoscopy is a technique that has to be preferred especially if the residual myometrial thickness is < 3 mm **(23).**

A skilled laparoscopic surgeon can use conventional laparoscopy or robotic-assisted surgery to correct the isthmocele. After the defect is identified, it is cut open and the isthmocele and the surrounding fibrotic tissue are trimmed carefully and removed from the edges of the defect to access the healthy myometrium **(24).**

Before closing, **Donnez et al. (24)** insert a Hegar probe into the cervix to preserve the continuity of the cervical canal with the uterus and perform a double-layer closure with separate sutures. The critical step of the laparoscopic procedure is to correctly identify the isthmocele. This can be done using various techniques: easily laparoscopic visualization after dissecting the uterovesical peritoneum; hysteroscopy performed at the same time of the laparoscopy to evaluate the uterine cavity and the defect; moreover, the hysteroscopic transillumination better reveals the edges of the defect. Hysteroscopic transillumination was easy safe method to identify the niche during laparoscopy termed it as Halloween sign and the technique of combined hysteroscopy and laparoscopy as rendez-vous technique

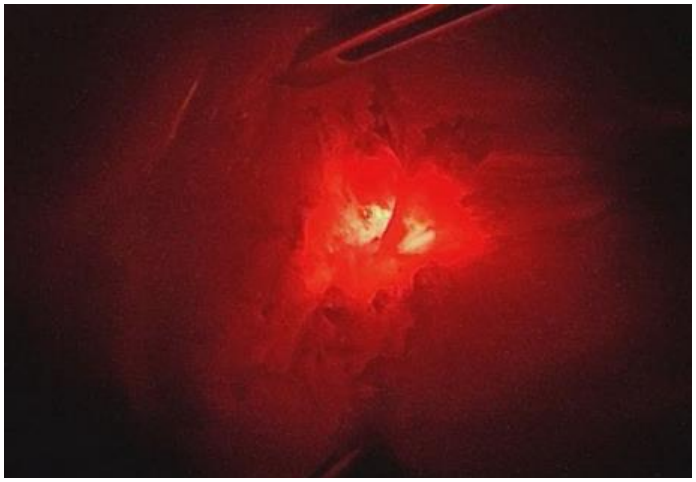

Figure (1): Halloween sign.

Figure (2): shows the lateral adhesion landmarks of cesarean scar niche

Krentel et al. (25) operate 9 cases in their study and showed that Laparoscopic fluorescence-guided niche detection using IGC mode represents a novel approach which might help to prevent bladder lesions and unnecessary tissue preparation.

Vervoort et al. (22) published the first large prospective cohort study that evaluated the effect of laparoscopic isthmocele resection on symptoms, on fertility, and on ultrasound findings, evaluating 101 women. **Vervoort et al. (22)** showed that the laparoscopic approach reduces postmenstrual spotting and its correlated discomfort, reduces dysmenorrhea, and enlarges the residual myometrial thickness 6 months after the intervention. The pregnancy rate after the laparoscopic approach is estimated to be 44%, as reported by **Donnez et al. (26).**

Complications occurred in five women, including one conversion to laparotomy from a vessel injury, one bleeding epigastric branch requiring a suture, two bladder lacerations and one uterine perforation. Although patient satisfaction was high, a learning curve was highlighted with recommendations for expertise and training in advanced laparoscopic techniques **(27).**

Novel laparoscopic surgery for the repair of cesarean scar defect without processing scar resection

Residual myometrium thickening occurred among all the 76 patients and the average residual myometrium thickness was increased to almost 6 mm, presenting no between-group difference. In Group A, all the CSD-related postmenstrual bleeding was resolved or improved, but one patient in Group B has no obvious change to postmenstrual bleeding. After CSD repair, 20 patients got pregnant naturally in Group A, and there was no cesarean scar pregnancy and uterine rupture. While, there were 9 cases of natural pregnancy in Group B. No uterine rupture occurred among these 9 pregnant women of Group B, but 1 case of pregnancy was terminated due to cesarean scar pregnancy **(5).**

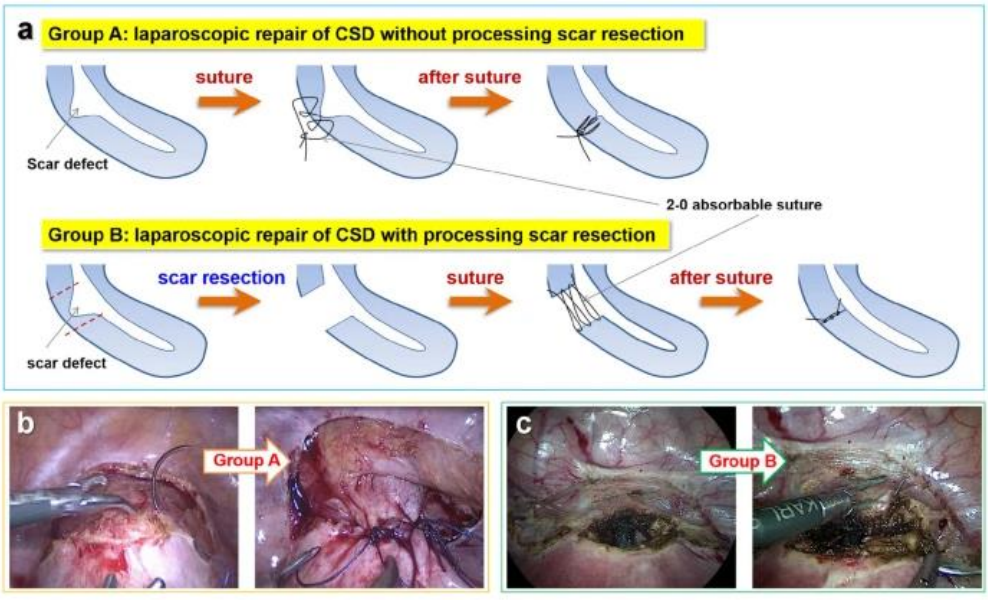

Figure (3): a A schematic overview of the method of laparoscopic repair CSD without (Group A) and with (Group B) processing scar resection; **b** laparoscopic suture upper and lower margin of the muscle layer in Group A; **c** laparoscopic excision of uterine scar defect and suture of the myometrium and serosa in Group B.

laparoscopic muscle flap filling technique:

This technique includes combined laparoscpic and hysteroscopic intervention, including laparoscpic mobilization of bladder and then hysteroscopic electroresection of the niche followed by monopolar partial inscision of myometrium above the upper limit of the niche followed by A 2-0 absorbable suture was used to bypass the muscle flap and continuously suture the muscle tissue above and below the niche, and the muscle flap was used to fill the niche. compared this technique with the same technique without muscle flapping and found no significant differences between two groups, however this may be due to relative small sample size (24 cases) **(22).**

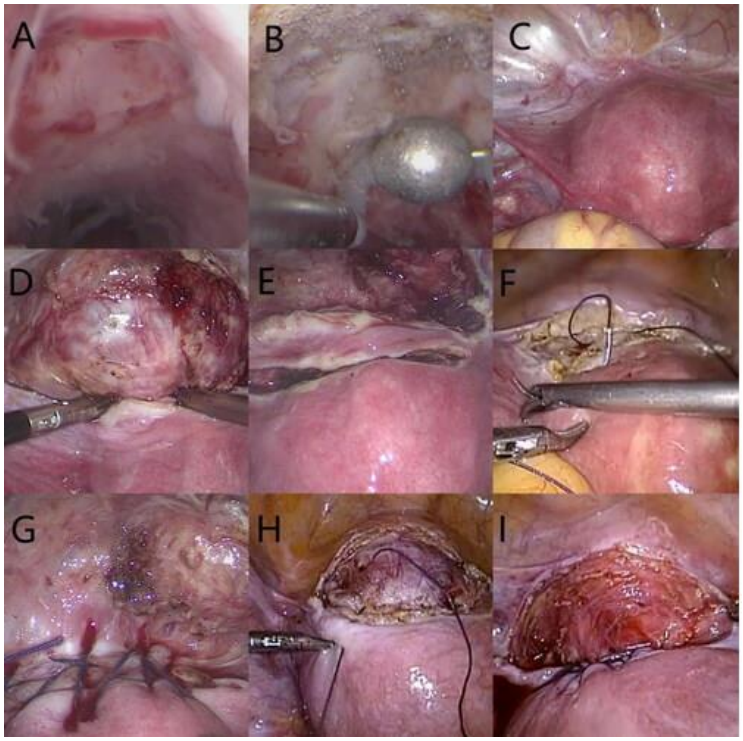

Figure (4): (A) Hysteroscopy of the cesarean scar defect (CSD). (B) Hysteroscopy after electrical resection of the scar (canal opening) and electrocoagulation of the diverticular endometrium. (C) Laparoscopy of the CSD. (D) Laparoscopic visualization of the diverticulum with guidance from the light source of the hysteroscope after opening and deflecting the vesicouterine pouch. (E) The muscle flap filling suture method: a monopolar electrical probe was used to make a transverse incision in the myometrium 1 cm above the diverticulum to a depth of approximately 0.5 cm. (F) The muscle flap filling suture method. (G) After muscle flap filling suture. (H) The folding suture method. (I) After folding suture.

Robotic and Robotic Assisted Isthmoplasty

Mahmoud and Nezhat, (28) described the procedure and it is quite similar to the laparoscopic repair. All the scar tissue of the defect is removed and the wall is closed using delayed absorbable suture. Chromoperturbation is used to confirm the water tightness of the repair.

Combined vaginal and laparoscopic repair of niche

For many gynecologist all steps of laparoscopic repair is feasible except endo-suture, Away to overcome this technical problem **Zhang et al. (16)** proposed combined single port laparoscopy assisted vaginal repair of cesarean scar niche.

They studied 74 patients who were diagnosed with uterine cesarean. Thirty-seven patients underwent single-port laparoscopy-assisted vaginal surgery as the case group, and the remaining patients underwent vaginal repair surgery as the control group.

Patients who underwent single-port laparoscopy-assisted vaginal repair had a significantly longer operation time (2.3 vs. 2.0 h, P = 0.015), shorter gas passage time (1.2 vs. 1.7 days, P = 0.012), shorter hospital stay (3.1 vs. 4.5 days, P = 0.019), and fewer complications (0 vs. 4 cases) **(29).**

Single Vs Double Layer Suture

The debate between single- and double-layer closures is not resolved readily, as no comparison studies were done. Some authors recommend a single-layer closure, wherein the full thickness of the myometrium, together with the serosa, is taken with the suture **(30).**

However, most prefer double-layer closure, wherein the first layer incorporates two-thirds of the myometrium and the second layer the remaining one-third of the myometrium together with the serosa **(31).**

Result of endoscopic repair

Postmenstrual Spotting/AUB

Regarding The hysteroscopic remodeling of an isthmocele is associated with an improved outcome. A recently published review stated that 59.6% to 100% of patients usually become asymptomatic after surgery **(32).** As opposed to **Wang et al. (27)** who reported a lower success rate, 100% of patients were asymptomatic after the surgery in other studies.

The success rate is probably dependent on the follow-up time, as seen by **Feng et al. (10)** who noted that 61% of patients were asymptomatic after the procedure, and a further 32% showed improvement (i.e., AUB was shortened).

Mashiach and Burke (32) in their systematic reveiw. could not find any technique that was better whether both edges or distal edge alone were remodeled.

Laparoscopy was shown to give similarly convincing results. From 64.1% to 100% of patients were asymptomatic after laparoscopic CSD repair. After laparoscopic surgery, **Vervoort et al. (22)** found that in 79.2% of patients, the main niche-related problem was improved at 6-months follow-up.

Although in most studies, the uterus was closed with a double layer; **Mashiach and Burke (32)** did not find a significant difference whether it was closed with a single or double layer.

Infertility

In a patient with secondary infertility in which an isthmocele is identified, after excluding other causes for infertility, repairing the isthmocele would be justified **(33).**

The results after **hysteroscopy** vary from a 46% pregnancy rate **cohen et al. (33)** to a 100% pregnancy rate and a 90% delivery rate.

With **laparoscopic** repair, the success rates are similar to 44% by **Donnez (26)**.

Pain/Dysmenorrhea

It is apparent that pain/dysmenorrhea are much less common than AUB, and most studies did not record data regarding pain. In the few reports that discussed these symptoms **Mashiach and Burke (32)** noted that with hysteroscopy, small studies of fewer than 10 women showed 78% improvement by **Gubbini et al. (14)** and 80% improvement by. **Enderle et al. (34)**.

Obstetrics / RMT

No prediction regarding uterine rupture is available. In a meta-analysis done regarding the thickness of uterine scar and likelihood or uterine rupture, **Swift et al. (35)** found that RMT >3.65 mm, measured using a standardized ultrasound technique, was associated with a lower likelihood of uterine rupture. However, whether this is true for a thinner RMT repaired by laparoscopy remains unclear.

Mashiach and Burke (32) found that RMT does increase after laparoscopic repair, the most significant increase being that performed by **Marotta et al. (36)** from 1.6 to 9.8 mm .Two studies found that the RMT increased after hysteroscopy as well, from 4.76 to 5.68 mm and from a low RMT of 2.1 to 4.2 mm.

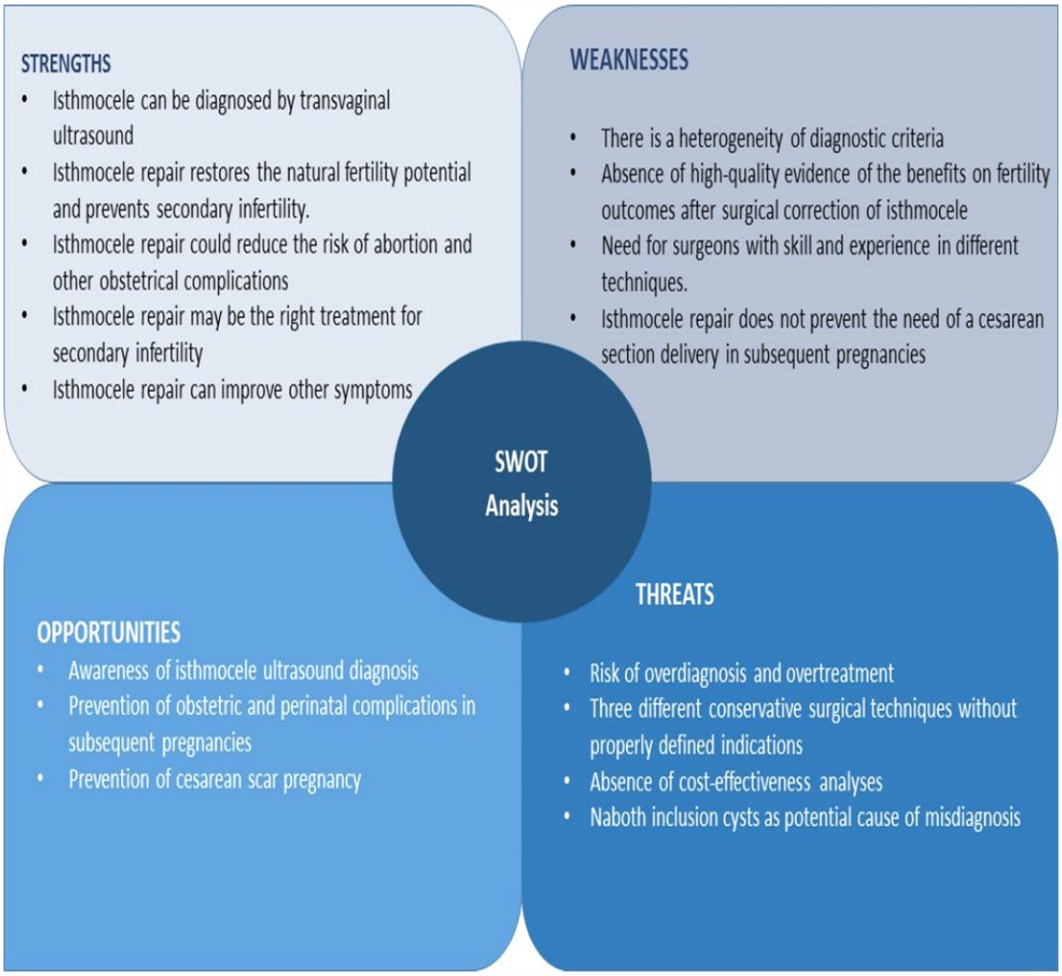

Figure (5): SWOT analysis for diagnosis and management of cesarean scar niche.

References:

1. **WHOHRP.** WHO statement on caesarean section rates. Sex Reprod Health. 2015; 2: 1- 8. (WHO/RHR/15.02).
2. **Poidevin L.** Caesarean section scar safety. Br Med J. 1959; 2(5159): 1058- 1061.
3. **Vervoort AJMW, Uittenbogaard LB, Hehenkamp WJK, Brölmann HAM, Mol BWJ, Huirne JAF.** Why do niches develop in caesarean uterine scars? Hypotheses on the aetiology of niche development. Hum Reprod. 2015; 30(12): 2695- 2702.
4. **Calì G, Timor-Tritsch IE, Palacios-Jaraquemada J, et al.** Outcome of caesarean scar pregnancy managed expectantly: systematic review and meta-analysis. Ultrasound Obstet Gynecol. 2018; 51(2): 169- 175.
5. **Kaelin Agten A, Cali G, Monteagudo A, Oviedo J, Ramos J, Timor-Tritsch I.** The clinical outcome of caesarean scar pregnancies implanted "on the scar" versus "in the niche". Am J Obstet Gyneco.

6. **Levy-Zauberman, Y., Pourcelot, A. G., Capmas, P., & Fernandez, H. (2017).** Update on the management of abnormal uterine bleeding. Journal of gynecology obstetrics and human reproduction, 46(8), 613-622.
7. **Iannone, P., Nencini, G., Bonaccorsi, G., Martinello, R., Pontrelli, G., Scioscia, M., ... & Scutiero, G.** Isthmocele: from risk factors to management. Revista Brasileira de Ginecologia e Obstetrícia, 2019, 41, 44-52.
8. **Fernandez E, Fernandez C, Fabres C, Alam VV.** Hysteroscopic correction of cesarean section scars in women with abnormal uterine bleeding. J Am Assoc Gynecol Laparosc. 1996;3:S13.
9. Indraccolo, U., Greco, P., Scutiero, G., Marrocchella, S., Sorrentino, F., Mastricci, L., & Matteo, M. (2014). The role of hysteroscopy in the diagnostic work-up of infertile asymptomatic patients. Clinical and experimental obstetrics & gynecology, 41(2), 124-127.
10. **Feng YL, Li MX, Liang XQ, Li XM.** Hysteroscopic treatment of postcesarean scar defect. J Minim Invasive Gynecol. 2012;19:498–502
11. **Chang Y, Tsai EM, Long CY, Lee CL, Kay N.** Resectoscopic treatment combined with sonohysterographic evaluation of women with postmenstrual bleeding as a result of previous cesarean delivery scar defects. Am J Obstet Gynecol. 2009;200:370.e1– 370.e4
12. **Li C, Guo Y, Liu Y, Cheng J, Zhang W.** Hysteroscopic and laparoscopic management of uterine defects on previous cesarean delivery scars. J Perinat Med. 2014;42:363–370
13. **Gubbini G, Casadio P, Marra E.** Resectoscopic correction of the "Isthmocele" in women with postmenstrual abnormal uterine bleeding and secondary infertility. J Minim Invasive Gynecol. 2008;15:172– 175.
14. **Gubbini G, Centini G, Nascetti D, et al.** Surgical hysteroscopic treatment of cesarean-induced isthmocele in restoring fertility: prospective study. J Minim Invasive Gynecol. 2011;18:234–237
15. **Florio P, Filippeschi M, Moncini I, Marra E, Franchini M, Gubbini G.** Hysteroscopic treatment of the cesarean-induced isthmocele in restoring infertility. Curr Opin Obstet Gynecol 2012; **24**: 180– 6.
16. **Zhang Y. A** comparative study of transvaginal repair and laparoscopic repair in the management of patients with previous cesarean scar defect. J Minim Invasive Gynecol. 2016;23:535–541.
17. **Raimondo G, Grifone G, Raimondo D, Seracchioli R, Scambia G, Masciullo V.** Hysteroscopic treatment of symptomatic cesareaninduced Isthmocele: a prospective study. J Minim Invasive Gynecol. 2015;22:297–301.
18. **Casadio P, Gubbini G, Morra C, Franchini M, Paradisi R, Seracchioli R.** Channel-like 360° Isthmocele Treatment with a 16F Mini-Resectoscope: A Step-by-step Technique. J Minim Invasive Gynecol. 2019 Nov-Dec;26(7):1229-1230.

19. **Cohen SB, Mashiach R, Baron A, Goldenberg M, Schiff E, Orvieto R, Bouaziz J.** Feasibility and efficacy of repeated hysteroscopic cesarean niche resection. Eur J Obstet Gynecol Reprod Biol. 2017 Oct;217:12-17.
20. **Tsuji S, Kimura F, Yamanaka A, Hanada T, Hirata K, Takebayashi A, Takashima A, Seko-Nitta A, Murakami T.** Impact of hysteroscopic surgery for isthmocele associated with cesarean scar syndrome. J Obstet Gynaecol Res. 2018 Jan;44(1):43-48. doi: 10.1111/jog.13464. Epub 2017 Sep 11. PMID: 28892298.
21. **Tsuji S, Takahashi A, Higuchi A, Yamanaka A, Amano T, Kimura F, Seko-Nitta A, Murakami T. Pregnancy outcomes after hysteroscopic surgery in women with cesarean** scar syndrome. PLoS One. 2020 Dec 3;15(12):e0243421.
22. **Vervoort A, van der Voet L, Hehenkamp W, Thurkow A, van Kesteren P, Quartero H, et al.** Hysteroscopic resection of a uterine caesarean scar defect (niche) in women with postmenstrual spotting: a randomised controlled trial. BJOG 2018;125:326–34.
23. **Liu SJ, Lv W, Li W.** Laparoscopic repair with hysteroscopy of cesarean scar diverticulum. J Obstet Gynaecol Res. 2016;42:1719– 1723.
24. **Donnez O, Donnez J, Orellana R, Dolmans MM.** Gynecological and obstetrical outcomes after laparoscopic repair of a cesarean scar defect in a series of 38 women. Fertil Steril. 2017;107:289–296.e2.
25. **Krentel H, Lauterbach L-K, Mavrogiannis G, De Wilde RL.** Laparoscopic Fluorescence Guided Detection of Uterine Niche—The Next Step in Surgical Diagnosis and Treatment. Journal of Clinical Medicine. 2022; 11(9):2657.
26. **Donnez O.** Cesarean scar defects: management of an iatrogenic pathology whose prevalence has dramatically increased. Fertil Steril. 2020; 113:704–716
27. **Wang CJ, Huang HJ, Chao A, Lin YP, Pan YJ, Horng SG.** Challenges in the transvaginal management of abnormal uterine bleeding secondary to cesarean section scar defect. Eur J Obstet Gynecol Reprod Biol. 2011;154:218–222
28. **Mahmoud, M. S., & Nezhat, F. R. (2015).** Robotic-assisted laparoscopic repair of a cesarean section scar defect. Journal of Minimally Invasive Gynecology, 22(7), 1135-1136.
29. **Perez-Medina T, Sancho-Sauco J, Rıos M, et al.** Hysteroscopy in pregnancy-related conditions: descriptive analysis in 273 patients. J Minim Invasive Gynecol. 2014;21:417–425
30. **Vegas Carrillo de Albornoz A, Lopez Carrasco I, Montero Pastor N, et al.** Outcomes after hysteroscopic treatment of symptomatic isthmoceles in patients with abnormal uterine bleeding and pelvic pain: a prospective case series. Int J Fertil Steril. 2019;13:108–112
31. **Tantini C, Viana GA, Gubbini G.** Cesarean scar defects: hysteroscopic treatment of isthmocele in menstrual disorders and infertility. Minimally Invasive Gynecology: An Evidence Based Approach. Springer International Publishing: New York, NY; 2018, 181–191
32. **Mashiach R, Burke YZ.** Optimal Isthmocele Management: Hysteroscopic, Laparoscopic, or Combination. J Minim Invasive Gynecol. 2021 Mar;28(3):565-574.

33. **Cohen SB, Bouaziz J, Bar On A, Orvieto R.** Fertility success rates in patients with secondary infertility and symptomatic cesarean scar niche undergoing hysteroscopic niche resection. Gynecol Endocrinol. 2020;36:912–916
34. **Enderle I, Dion L, Bauville E, et al.** Surgical management of isthmocele symptom relief and fertility. Eur J Obstet Gynecol Reprod Biol. 2020;247:232–237.
35. **Swift BE, Shah PS, Farine D.** Sonographic lower uterine segment thickness after prior cesarean section to predict uterine rupture: a systematic review and meta-analysis. Acta Obstet Gynecol Scand. 2019;98:830–841.
36. **Marotta ML, Donnez J, Squiffflet J, Jadoul P, Darii N, Donnez O.** Laparoscopic repair of post-cesarean section uterine scar defects diagnosed in nonpregnant women. J Minim Invasive Gynecol. 2013; 20:386–391.