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Reproductive outcomes following hysteroscopic uterine septum resection in infertile women: a retrospective cohort study

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Abstract

Objective A septate uterus is a common congenital anomaly often identified during infertility evaluations and is associated with adverse reproductive outcomes. Hysteroscopic septum resection is widely recognized as a standard, safe, and effective treatment. This study aimed to evaluate reproductive and pregnancy outcomes in infertile women who underwent hysteroscopic septum resection.

Method This retrospective cohort study included infertile women aged 18 to 45 years who were diagnosed with a uterine septum and were candidates for assisted reproductive technology (ART) between 2011 and 2021. Participants had either primary or secondary infertility and underwent hysteroscopic septoplasty. Data were collected from medical records and telephone interviews, which included demographic information and postoperative outcomes, such as chemical and clinical pregnancy rates, live birth rates, and adverse pregnancy outcomes. Statistical analyses employed descriptive methods, including frequencies and means.

Results Among 735 women, 84.6% had primary infertility, and 51.5% had infertility for 1–5 years. The chemical pregnancy rate was 44.6%, clinical pregnancy 42.8%, and live birth 36.7%. No significant differences were found between primary and secondary infertility groups in pregnancy or live birth rates. Adverse outcomes included preterm labor (6.7%) and preeclampsia (4.8%). Vaginal delivery was the most common mode (81.8%).

Conclusion Hysteroscopic septum resection appears to improve pregnancy outcomes and live birth rates in individuals undergoing ART. Nevertheless, prospective studies with control groups are needed to confirm these findings and establish stronger evidence.

Keywords Hysteroscopy, Septate uterus, Infertility, Pregnancy outcomes

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Introduction

Congenital uterine abnormalities, which affect approximately 5.5% of the population, can impair uterine functions, leading to reduced fertility and adverse pregnancy outcomes [1]. A septate uterus is a common congenital uterine anomaly that occurs when the paramesonephric/Müllerian ducts fail to fully resorb during the embryonic phase. Its prevalence is estimated to range from 0.2 to 2.3% among women of reproductive age, varying based on the diagnostic criteria and classification systems used [2]. A septate uterus is characterized by the presence of a partition (septum) dividing the uterine cavity, with no restriction on the septum's size [3, 4]. This anomaly can be partial, affecting a portion of the uterine cavity, or complete, dividing the uterine cavity into two distinct compartments [5].

Although a septate uterine is not a primary cause of infertility, it is frequently diagnosed during infertility treatments. Moreover, it is associated with adverse reproductive outcomes [6]. Women with a septate uterus are at an increased risk of malpresentation, first- and second-trimester miscarriages, subfertility, infertility, and preterm delivery [1, 7]. A literature review by the American Society for Reproductive Medicine found that women with a septate uterus have a significantly increased risk of adverse pregnancy outcomes compared to the general population. Specifically, they are more likely to experience early miscarriage (41.1% vs. 12.1%), late miscarriage (12.6% vs. 6.9%), and preterm delivery. Additionally, women with a septate uterus have higher rates of malpresentation, intrauterine growth restriction, placental abruption, and perinatal death [8].

The exact mechanisms by which a uterine septum contributes to poor reproductive outcomes and infertility are not fully understood. Potential factors include reduced uterine capacity, structural abnormalities in the septal endometrium, and a suboptimal estrogen response in the fibroelastic, poorly vascularized tissue covering the septum [9].

Hysteroscopic septum resection has been established as a standard, safe, and effective treatment method. However, debate persists regarding its indications [10]. Some studies have reported improved pregnancy rates, live birth rates, and reductions in miscarriage, preterm labor, and ectopic pregnancy following hysteroscopic septum resection [5, 10–13]. In contrast, a cohort study of 257 women found no significant improvement in reproductive outcomes following septum resection [14]. Additionally, a multicenter clinical trial by Rikken et al. reported no differences in reproductive outcomes between surgical and expectant management [2].

Recognizing the septate uterus as a potential contributor to infertility, along with the ongoing debate surrounding the role of hysteroscopy in such cases, this study aims to investigate pregnancy outcomes in infertile women who have undergone hysteroscopic septoplasty.

Methods

Study design and population

This retrospective cohort study included infertile women diagnosed with a uterine septum who were referred to Yas Hospital in Tehran, Iran, for fertility treatment between 2011 and 2021. Ethical approval was granted by the Research Ethics Committee of the School of Medicine at Tehran University of Medical Sciences on September 10, 2022 (Approval No. IR.TUMS.MEDICINE.REC.1401.468).

Infertility was categorized as primary or secondary. Primary infertility was defined as the inability to conceive after 12 months of regular unprotected intercourse in women who had never previously conceived. Secondary infertility was defined as the inability to conceive after 12 months of regular unprotected intercourse in women who had previously conceived at least once.

Hysteroscopic septoplasty was performed to address the potential adverse effects of a uterine septum on reproductive outcomes. While not universally considered a primary cause of infertility, as previously discussed, a septate uterus has been associated with reduced implantation rates, increased miscarriage rates, and adverse pregnancy outcomes. The decision to perform septoplasty was based on clinical findings, infertility investigations, and patient history, with the goal of improving uterine receptivity and optimizing outcomes, particularly for women undergoing assisted reproductive treatments (ART). For women with primary infertility, hysteroscopic septoplasty was offered as part of our center's clinical practice, owing to the potential impact of uterine septa on implantation and pregnancy maintenance in cases of unexplained primary infertility.

To further assess the impact of septoplasty on different patient subgroups, we stratified results based on primary versus secondary infertility and included an analysis of reproductive outcomes across these groups.

Classification of infertility factors

The etiology of infertility was classified based on clinical, hormonal, and diagnostic evaluations performed at our infertility clinic. Female factor infertility included ovulatory disorders, tubal factor infertility, endometrial abnormalities, and unexplained infertility. Male factor infertility was defined according to semen analysis parameters following the latest World Health Organization (WHO) criteria. Cases of idiopathic infertility were categorized separately when no identifiable cause was found after standard evaluations.

Inclusion and exclusion criteria

Participants were women aged 18–45 years with primary or secondary infertility or a history of recurrent miscarriage, defined as two or more first- or second-trimester losses of a singleton pregnancy, who were candidates for ART.

Inclusion criteria required:

- Normal female hormonal profile, and normal thyroid function.
- Bilaterally patent fallopian tubes confirmed by hysterosalpingography (HSG).
- Normal anti-Müllerian hormone (AMH) levels.
- No history of live birth, uterine surgeries, or significant medical conditions.

Diagnosis of a uterine septum was established via HSG, saline infusion sonography, or hysteroscopy and confirmed using HSG, diagnostic hysteroscopy, and laparoscopy to exclude other anomalies and endometriosis.

Exclusion criteria included:

- Endometriosis, adenomyosis.
- Severe male factor infertility.
- Incomplete medical records.

Surgical procedure

All hysteroscopic septoplasties were performed postmenstrually using bipolar instruments with isotonic saline as the distending medium. Intrauterine pressure was maintained at 80 mmHg using an automated infusion pump. Cervical dilation to 10 mm was achieved with Hegar's dilators.

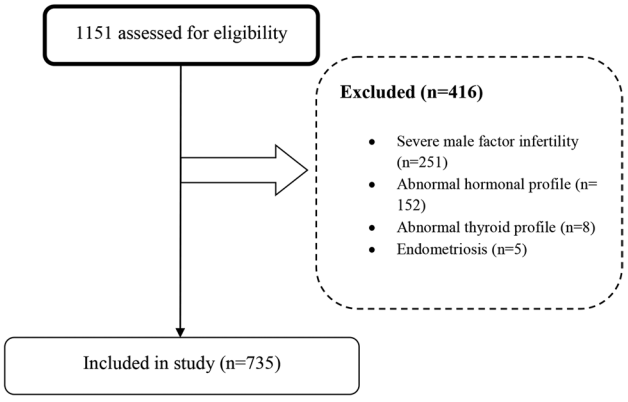

Fig. 1 Flow chart of the study process. Caption: A total of 1,151 women who were candidates for assisted reproductive technology (ART) and had undergone hysteroscopic resection of a uterine septum prior to ART were assessed for eligibility. After excluding cases with severe male factor infertility (n=251), abnormal hormonal profiles (n=152), abnormal thyroid profiles (n=8), and endometriosis (n=5), 735 women were included in the study

The 30-degree continuous-flow hysteroscope and knife electrodes were used for septum resection. General or spinal anesthesia was administered based on anesthesiologist evaluation. Prophylactic antibiotics were given to all patients. Postoperative assessment included HSG after the first menstrual cycle to confirm complete resection and check for adhesions. Procedures were performed by experienced surgeons to minimize risks of perforation and scarring.

Follow-up

Patients were followed for at least nine months postoperatively to monitor assisted ART outcomes, and pregnancy-related events, including miscarriage, preterm birth, and term delivery.

Data collection

Medical records were reviewed to identify eligible participants. Data on demographics (age, education, occupation), reproductive history (duration and type of infertility), surgical details, and clinical outcomes were collected using a standardized checklist. Missing follow-up data were supplemented through telephone interviews. Postoperative outcomes evaluated included day-14 β-HCG, implantation rate, chemical pregnancy, clinical pregnancy, live birth, preterm labor, preeclampsia, previa, abortion, cervical cerclage, twin pregnancies, breech presentations, cesarean deliveries, endometrial thickness, and implanted embryo characteristics.

Statistical analysis

Descriptive statistics, including frequency and mean, were used to summarize demographic and clinical data. IBM SPSS version 26.0 was employed for statistical analyses.

Post-Procedure care and outcome measures

All patients underwent ART following septum resection. The choice of treatment, including in vitro fertilization (IVF) or intracytoplasmic sperm injection (ICSI) was tailored to each patient's infertility profile. Primary outcomes included pregnancy rates (chemical and clinical) and live birth rates. Secondary outcomes encompassed adverse pregnancy events such as preterm labor, miscarriage, and delivery mode.

Results

A total of 735 women participated in the study (Fig. 1. Flowchart of study participants). Table 1 summarizes their demographic characteristics. Most participants (47.8%) were aged 26–35 years, 73.8% had a university education, and 72.5% were homemakers. The duration of infertility was 1–5 years for 51.5% of the participants.

Table 1 Demographic characteristics of the studied population

Variables		Number	percent
Age (year)	15–25	64	8.7
	26–35	351	47.8
	36–45	320	43.5
Education	< High school	36	5.8
	High school	128	20.4
	University	462	73.8
Occupation	Housekeeping	465	72.5
	Employed	176	27.5
Marriage duration (year)	1–5	254	34.6
	6–10	278	37.8
	11–15	174	23.7
	16–20	27	3.7
	21–25	2	0.3
Infertility duration (year)	1–5	376	51.4
	6–10	231	31.6
	11–15	111	15.2
	16–20	12	1.6
	21–25	2	0.3
Cause of infertility	Female	395	53.7
	Male	75	10.2
	Idiopathic	265	36.1
Infertility type	Primary	622	84.6
	Secondary	113	15.4
Body Mass Index (Kg/m^2)	< 18.5	12	1.7
	18.5-<25	584	80.4
	25- <30	122	16.8
	≥ 30	8	1.1

The table presents the demographic and clinical characteristics of the study participants. Age was categorized into three groups: 15–25, 26–35, and 36–45 years. Education level was classified as below high school, high school, or university degree. Occupation was recorded as either housekeeping (unemployed) or employed. Marriage duration and infertility duration were both reported in years, representing the length of time since marriage and the period of infertility before seeking treatment, respectively. The cause of infertility was classified into female factor, male factor, or idiopathic (unexplained) infertility. Infertility type was categorized as primary, referring to women with no previous pregnancies, or secondary, referring to women with prior pregnancies. Body Mass Index (BMI) was classified based on the WHO categories: underweight (< 18.5 kg/m^2), normal weight (18.5–<25 kg/m^2), overweight (25–<30 kg/m^2), and obese (≥ 30 kg/m^2)

Primary infertility was reported in 84.6% of cases. The mean BMI of the participants was 22.38 kg/m².

Table 2 indicates that 44.8% of women achieved successful implantation, and 38.4% experienced a clinical pregnancy. Abortion occurred in 6.1% of participants. Adverse pregnancy outcomes, including preterm labor, preeclampsia, and breech presentation, were observed in 6.7%, 4.8%, and 3.7% of cases, respectively. Vaginal delivery was the predominant mode of delivery, reported in 81.8% of participants. The mean endometrial thickness at the time of injection and transfer was 8.46 cm and 8.3 cm, respectively.

Reproductive outcomes were compared between the two groups (Table 3). The chemical pregnancy rate was 44.8% in the primary infertility group and 44.2% in the secondary infertility group ($p = 0.497$). Similarly, clinical pregnancy rates were 43.2% and 42.5%, respectively ($p = 0.485$). The live birth rate was slightly higher in the primary infertility group (37.5%) compared to the secondary infertility group (33.6%), but the difference was not statistically significant ($p = 0.247$).

Regarding the characteristics of the implanted embryos, the most frequent combinations were two 8-cell embryos with grades B and C (30.6%) and grades A and B (22.7%) (Table 4).

Table 2 Clinical outcomes in the studied population

Variables	Positive	Negative
	N **(Valid percent)**	***N*** **(Valid percent)**
Chemical pregnancy	328 (44.6)	407 (55.3)
Clinical pregnancy	315 (42.8)	420 (57.1)
Live birth	270 (36.7)	465 (63.2)
Preterm labor	49 (6.7)	686 (93.3)
Preeclampsia	35 (4.8)	700 (95.2)
Previa	8 (1.1)	727 (98.9)
Abortion	45 (6.1)	690 (93.8)
Cervical cerclage	42 (5.7)	693 (94.3)
Twin	35 (4.8)	700 (95.2)
Breech	27 (3.7)	708 (96.3)
Cesarean section	134 (18.2)	601 (81.8)
Vaginal delivery	601 (81.8)	134 (18.2)
Endometrial thickness	**Mean**	**± Std. Deviation**
Start cycle	1.18	0.38
Progesterone injection time	8.46	0.63
Transfer time	8.30	0.65

Table 3 Reproductive outcomes in women with primary and secondary infertility

Outcome	Primary Infertility ***N*** **(Valid percent)**	Secondary Infertility ***N*** **(Valid percent)**	***p*-value**
Chemical pregnancy	277 (44.8)	50 (44.2)	0.497
Clinical pregnancy	267 (43.2)	48 (42.5)	0.485
Live birth	232 (37.5)	38 (33.6)	0.247
Abortion	35 (5.7)	10 (8.8)	0.140

Fisher's exact tests were performed to assess statistical differences between the groups. A p-value of <0.05 indicates statistically significant differences between primary and secondary infertility groups for each outcome

Discussion

This study evaluated the reproductive outcomes of women undergoing hysteroscopic septum resection, revealing notable findings. A live birth rate of 36.7% were observed among participants, all of whom underwent ART postoperatively. These results suggest that septum resection may improve uterine receptivity, thereby contributing to positive reproductive outcomes, even in a population with infertility challenges.

These findings align with prior studies demonstrating improved reproductive outcomes following hysteroscopic

Table 4 Frequency of implanted embryos' characteristics

Embryo Number	Cell number/ Grade	*N*	Valid Percent
1	8/A	21	2.9
	8/A, B	1	0.1
	8/B	16	2.2
	8/C	10	1.4
	BLAST	4	0.5
	BLAST/A	8	1.1
	BLAST/B, C	2	0.3
	COMPACT	1	0.1
	COMPACT/A	1	0.1
	COMPACT/B	1	0.1
	COMPACT/C	2	0.3
2	4/C	2	0.3
	6/A, B	2	0.3
	8/A	57	7.8
	8/A, B	167	22.7
	8/A, C	14	1.9
	8/B	55	7.5
	8/B, C	225	30.6
	8/C	34	4.6
	BLAST/A, B	9	1.2
	BLAST/A, C	1	0.1
	BLAST/B	3	0.4
	BLAST/B, C	2	0.3
	BLAST/A	2	0.3
	COMPACT/A, B	6	0.8
	COMPACT/B, C	2	0.3
3	4/A, B	2	0.3
	8/A	5	0.7
	8/A, B	11	1.5
	8/A, B, C	38	5.2
	8/B	5	0.7
	8/B, C	13	1.8
	8/C	4	0.5
	COMPACT	2	0.3
4	8/B, C	7	1.0

septoplasty, although variability exists in the reported success rates. Al-Husban et al. reported a spontaneous conception rate of 27.9% following septum excision, and observed a pregnancy rate of 50% in individuals who had previously experienced failed IVF cycles [15]. In contrast, another study demonstrated a significantly higher conception rate of 91.4% and a live birth rate of 78.6% following surgical septum resection [16].

The findings of a study on women with secondary infertility are also consistent with our results, showing that among individuals who underwent uterine septum resection prior to embryo transfer, the pregnancy rate was 54.9% and the live birth rate was 37.2%. In contrast, women without septum resection who also underwent embryo transfer had lower pregnancy (40.6%) and live birth rates (32.9%) [17].

In this study, the majority of participants (86.4%) had primary infertility, which is notably higher than the proportion of secondary infertility cases. This distribution may reflect referral patterns to our infertility clinic, where primary infertility is often a primary concern for couples seeking ART. Additionally, women with secondary infertility, particularly those with a history of miscarriage, may be more likely to attempt natural conception before pursuing ART, leading to their underrepresentation in our cohort.

Hysteroscopic septoplasty removes tissue that may hinder implantation and improves endometrial receptivity by enhancing blood flow. This can potentially increase the likelihood of successful pregnancy [18]. It is believed that the septum consists of fibrous tissue with poor blood supply and abnormal connections between the muscle and lining layers of the uterus, which may negatively impact fetal development and implantation [19].

In this study, the incidence of adverse pregnancy outcomes was as follows: preterm labor (6.7%), preeclampsia (4.8%), miscarriage (6.1%), breech presentation (3.7%), and placenta previa (1.1%).

A meta-analysis has shown that women with a uterine septum experience poorer reproductive outcomes compared to those with other uterine anomalies. Specifically, a uterine septum is associated with lower clinical pregnancy rates, higher first-trimester miscarriage rates, increased risk of preterm delivery, and adverse fetal presentations [20]. Additionally, hysteroscopic septum resection has been linked to a significant reduction in the likelihood of spontaneous miscarriage and preterm labor [18]. A study by Chen et al. found that in the IVF/ICSI group, the rates of early labor and miscarriage were 3.3% and 26.1%, respectively, for those who underwent septum resection, compared to 6.6% and 42.1%, respectively, in the non-resection group [17]. Furthermore, another study reported improvements in reproductive outcomes for individuals who underwent IVF both before and after septum resection [21].

However, it is important to note that some studies have not found significant differences in reproductive outcomes between IVF/ICSI cycles with and without septum resection [22, 23]. These inconsistencies may stem from variations in study design, sample size, embryo quality, and patient characteristics, highlighting the need for further research to clarify the role of septum resection in ART outcomes.

Furthermore, some early investigations suggest that septum resection does not impact pregnancy rates but improves reproductive outcomes [22].

Despite the conflicting findings in the literature and the fact that our study, while benefiting from a sufficient sample size and the inclusion of all patients from a single center to minimize bias from varied treatment

methods, remains a retrospective analysis that may be influenced by confounding variables. It is important to note that hysteroscopic septum resection is a technically simple procedure with minimal postoperative complications. Although the impact of uterine septum resection on fertility outcomes remains debated in various studies, the results of this study suggest that septal resection may improve pregnancy rates and reproductive outcomes, particularly when performed prior to IVF/ICSI cycles.

Limitations

While our study offers valuable insights into reproductive outcomes following hysteroscopic septum resection, several limitations should be acknowledged. First, the retrospective design may introduce selection bias and restrict our ability to establish causality. Second, since all participants were candidates for ART, the generalizability of our findings may be limited. Although hysteroscopic septum resection is thought to enhance natural conception rates, our study did not assess spontaneous pregnancy outcomes. Future research should include a control group of women who attempt natural conception following septum removal to more accurately evaluate its overall impact.

Additionally, the high proportion of women with primary infertility may have influenced the observed outcomes, as this group may possess distinct reproductive characteristics compared to those with secondary infertility. The study also included a significant percentage of cases with both male and female factor infertility, which could have impacted treatment success rates. Furthermore, IVF and ICSI treatments were combined without differentiation. Future studies should consider stratifying outcomes by infertility type, ART method, and other confounding factors to provide a more nuanced understanding of the effects of hysteroscopic septum resection on fertility outcomes.

Conclusion

This study supports the beneficial impact of hysteroscopic septum resection on reproductive outcomes in individuals undergoing IVF. Given the significant reduction in adverse pregnancy outcomes, such as preterm labor and miscarriage, septum resection should be considered a viable option to improve ART success rates. However, definitive conclusions require prospective studies with larger sample sizes, longer follow-up periods, and control groups.

Abbreviations

ART	Assisted Reproductive Technology
β-HCG	Beta-Human Chorionic Gonadotropin
IVF	In Vitro Fertilization
ICSI	Intracytoplasmic Sperm Injection
HSG	Hysterosalpingography
AMH	Anti-Müllerian Hormone
BLAST	Blastocyst (stage of embryo development)
SPSS	Statistical Package for the Social Sciences

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Author contributions

All named authors meet the International Committee of Medical Journal Editors (ICMJE) criteria for authorship for this article, take responsibility for the integrity of the work as a whole, and have given their approval for this version to be published. F.D.T.: Study's design. Z.K.: Conceptualization and supervision H.P. and S.S. and S.S.S: Data Gathering assessed and confirmed by the senior author. E.F.: Analysis. M.G. and M.D: Manuscript Writing and Editing. All authors critically revised successive drafts of the paper and approved the final version.

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Data availability

The data is available upon request.

Declarations

Ethics approval and consent to participate

The study was approved by the Research Ethics Committee of the School of Medicine, Tehran University of Medical Sciences, Tehran, Iran (No. IR.TUMS.MEDICINE.REC.1401.468). The patients provided written informed consent before participating in the study.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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