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CLINICAL RESEARCH / KLİNİK ARAŞTIRMA

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Evaluation of the Correlation Between Preoperative Anterior Wall Myometrium Thickness and Uterine Closure Techniques in the Development of Uterine Scar Defect (Niche) After Previous Caesarean Section

Geçirilmiş Sezaryen Sonrası Uterin Skar Defekti (Niş) Gelişiminde Preoperatif Anterior Duvar Myometrium Kalınlığı ve Uterus Kapatma Teknikleri Arasındaki Korelasyonun Değerlendirilmesi

Raziye Torun[1], Mustafa Şengül[2], Emine Demirel[3], Emre Ekmekci[4], Sefa Kelekci[2]

[1]İzmir City Hospital, Clinic of Obstetrics and Gynecology, Division of Perinatology, İzmir, Türkiye
[2]İzmir Katip Çelebi University Atatürk Training and Research Hospital, Clinic of Obstetrics and Gynecology, İzmir, Türkiye
[3]University of Health Sciences Türkiye, İzmir Tepecik Education and Research Hospital, Clinic of Obstetrics and Gynecology, Division of Perinatology, İzmir, Türkiye
[4]Şanlıurfa Training and Research Hospital, Clinic of Obstetrics and Gynecology, Division of Perinatology, İzmir, Şanlıurfa, Türkiye

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Abstract

Objective: The objective was to evaluate the correlation between the development of uterine scar defect (niche) following cesarean section, preoperative thickness of the anterior wall myometrium, and uterine closure techniques.

Methods: In a prospective randomized study, the preoperative anterior myometrial thickness of 75 women scheduled for cesarean delivery was measured. Single and double-layer uterine closure techniques were employed during surgery. Patients were evaluated postoperatively in the 6th to 8th weeks using transvaginal ultrasonography for uterine niche.

Results: No statistically significant correlation was found between preoperative anterior wall myometrial thickness and the height, area, base, and width of the niche identified by transvaginal ultrasonography. In the group undergoing double-layer continuous unlocked suture technique, the niche area was significantly larger (p=0.023). No statistical differences were found between preoperative hemoglobin (HB) and hematocrit (HCT) values, but postoperative 6th and 24th hour HB and HCT levels were significantly lower in patients with double-layer uterine closure (p<0.05).

Conclusion: Selecting a continuous suturing technique without locking can significantly reduce the area of the developing uterine scar defect. Furthermore, postoperative declines in HB and HCT can be minimized. Although sufficient data has not yet been reached to clearly define an operation technique that reduces niche formation, further studies with larger series are needed.

Keywords: Cesarean scar defect, uterine niche, cesarean section

Address for Correspondence/Yazışma Adresi: Raziye Torun MD, İzmir City Hospital, Clinic of Obstetrics and Gynecology, Division of Perinatology, İzmir, Türkiye
E-mail: drraziyetorun@gmail.com
ORCID ID: orcid.org/0000-0002-0272-7196

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Öz

Amaç: Sezaryen sonrası uterin skar defekti (niş) gelişiminde preoperatif anterior duvar myometrium kalınlığı ve uterus kapatma teknikleri arasındaki korelasyonun değerlendirmesi amaçlandı.

Yöntem: Prospektif randomize çalışmada sezaryenle doğum planlanan 75 gebenin preoperatif anterior myometriyum kalınlığı ölçüldü ve operasyonda tek kat ve çift kat uterin kapatma tekniği uygulandı. Hastalar postoperatif 6.-8. haftada uterin niş açısından transvajinal ultrasonografi ile değerlendirildi.

Bulgular: Preoperatif anterior duvar myometrium kalınlığının transvajinal ultrasonografi ile tespit edilen nişin yükseklik, alan, taban ve genişliği ile arasında istatistiksel olarak anlamlı fark bulunamadı. Geçirilmiş sezaryen endikasyonu ile sezaryen yapılan ve uterusu tek kat ve çift kat kapama uygulanan hastalar arasında, çift kat devamlı kilitsiz sütüre edilen grupta niş alanı anlamlı yüksek bulunmuştur (p=0,023). Preoperatif hemoglobin (HB) ve hemotokrit (HCT) değerleri arasında istatistiksel anlamda bir fark bulunmayan eski sezaryenli tek kat uterin kapatma ile çift kat uterin kapatma arasında postoperatif 6. ve 24. saat HB ve HCT değerleri çift kat uterin kapatma yapılan hastalarda istatistiksel olarak düşük bulundu (p<0,05).

Sonuç: Tek kat kilitlemeden devamlı sütür tekniği seçilerek gelişecek uterin skar defektinin alanı önemli ölçüde azaltılabilir. Ayrıca postoperatif HB ve HCT düşüşü azaltılabilir. Niş oluşumunu azaltan net bir operasyon tekniğinin tanımlanabilmesi için yeterli veriye ulaşamamakla birlikte daha geniş serili çalışmalara ihtiyaç vardır.

Anahtar Kelimeler: Sezaryen skar defekti, uterin niş, sezaryen

Introduction

The World Health Organization (WHO) recommends a cesarean section (CS) rate of 15% to optimize maternal and perinatal mortality outcomes. However, global CS rates have increased in recent years, and Türkiye has one of the highest rates in the world, at 48 percent, according to the Türkiye Demographic and Health Survey 2013. Cesarean delivery, particularly repeat cesarean delivery, is associated with increased risks of uterine rupture, abnormal placental implantation, placental abruption, and uterine scar dehiscence in subsequent pregnancies[1-3]. A uterine niche, identified via sonography, is characterized by a hypoechoic area within the myometrium of the lower uterine segment, indicating disruption of the myometrium at the site of a previous CS[4-6].

A niche is an indentation within the myometrium that is at least 1 mm deep. Transvaginal ultrasonography (TVS) shows an anechoic area with a depth of ≥1 mm in the cesarean scar[4,7]. Incomplete healing of a cesarean scar is a long-term complication that can lead to gynecological disorders that adversely affect a patient's quality of life, including abnormal uterine bleeding, postmenstrual spotting, dysmenorrhea, dyspareunia, chronic pelvic pain, and secondary infertility[5,7-9]. Given the association between uterine niches and gynecological symptoms, obstetric complications, and potential subfertility, elucidating the etiology of niche development post-cesarean is crucial for developing preventive strategies[10]. This study aimed to evaluate the correlation between preoperative anterior wall myometrial thickness and uterine closure techniques in the development of uterine scar defects following cesarean surgery.

Materials and Methods

This prospective, randomized, double-blind, parallel-group study was approved by the Ethics Committee of İzmir Katip Çelebi University Atatürk Training and Research Hospital (approval no: 44, date: 25.02.2016). Seventy-five consecutive singleton pregnant women requiring emergency or elective CS were enrolled at the Department of Obstetrics and Gynecology, İzmir Katip Çelebi University Atatürk Training and Research Hospital between February 2016 and November 2016, in accordance with the Helsinki Declaration principles. The exclusion criteria were a history of previous CS or other uterine surgeries, active labor exceeding 5 hours, cervical dilation over 4 cm, history of pelvic radiation, bleeding diathesis, connective tissue disease, preeclampsia, eclampsia, HELLP (hemolysis, elevated liver enzymes, low platelet) syndrome, gestational or pre-gestational diabetes, multiple pregnancies, preterm pregnancies (<37 weeks gestation), placental placement and invasion anomalies, and history of cervical cancer.

To ensure reliability and reproducibility, preoperative transabdominal sonography of anterior wall myometrial thickness and postoperative TVS screening for uterine niches at 6-8 weeks were conducted by the same researcher (R.T.). Anterior wall myometrial thickness and postpartum uterine niche dimensions were measured using 3-5 MHz transabdominal and 7.5-MHz transvaginal probes, respectively (Figure 1, 2). To minimize the effects of respiration and abdominal tension, participants were instructed to lie supine with a semi-full bladder and hold their breath during the measurements. Myometrial thickness was measured

approximately 4 cm above the internal cervical os, as demonstrated in the study by Uharček et al.[11].

The Modified Misgav Ladach method was used for cesarean delivery[12]. Uterine closure techniques included continuous single-layer sutures without locking and continuous double-layer sutures without locking, incorporating full-thickness myometrial and endometrial tissues along the lower segment incision line. Participants who underwent their first CS were sutured using a continuous single-layer without locking (Group 1). Those with previous cesareans (1-3 prior) were randomly assigned to either a continuous single-layer without locking (Group 2) or a continuous double-layer without locking (Group 3). Hemograms assessing white blood cell (WBC) count, hemoglobin (HB), and hematocrit (HCT) were obtained at 6 and 24 hours postoperatively, and

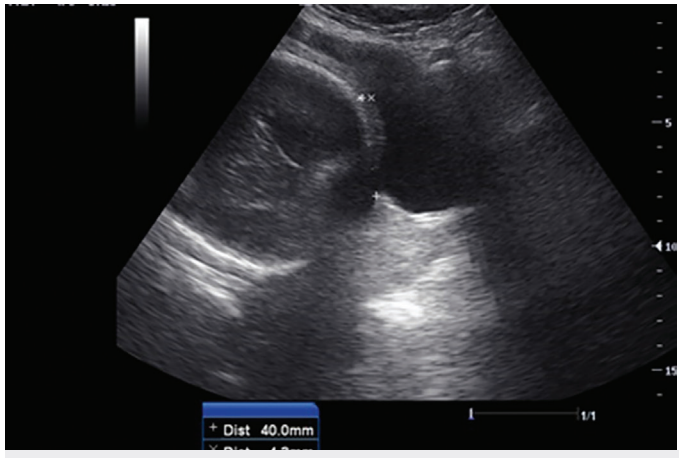

Figure 1. Transabdominal ultrasound image of the measurement of preoperative anterior wall myometrial thickness

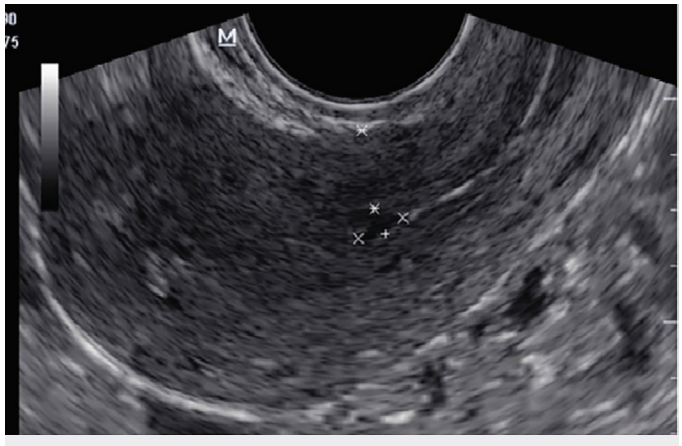

Figure 2. Transvaginal ultrasound image of the uterine niche in a patient undergoing cesarean for the first time

data were recorded. At 6-8 weeks postoperatively, all patients underwent TVS to assess uterine niches without knowledge of the surgical technique used, following the methodology of Pomorski et al.[13].

The presence of a niche at the uterine incision line was evaluated in both the transverse and midsagittal longitudinal planes. The depth, length, and residual anterior wall myometrial thickness of the niche were also measured. Considering the uterine niche's resemblance to an isosceles triangle, its area was calculated using the formula: base × height/2[14]. Based on the calculated area, uterine niches were classified into three grades: Grade 1 (<15 mm^2), Grade 2 (16-25 mm^2), and Grade 3 (>25 mm^2)[15]. A niche was considered large if the ratio of the niche height to the sum of the niche height and residual myometrial tissue was ≥50%, as per Bij de Vaate et al.[16].

Of the 117 patients who met the study criteria, 90 consented to participate. After excluding 15 dropouts, 75 patients were included in the final analysis. All participants underwent TVS 6-8 weeks post-cesarean section. No morbidity or mortality events were reported.

Statistical Analysis

The statistical analysis of the data was performed using the IBM SPSS statistics version 24 software package. The Pearson chi-square, Fisher's exact test, and chi-square test were used to compare categorical data between groups; the independent sample t-test and Mann-Whitney U statistical analyses were used for continuous data based on normal distribution properties. One-way ANOVA was used to test whether there was a statistically significant difference between the means of the independent groups that conformed to the normal distribution, and Kruskal-Wallis H analysis was used to compare the test scores of different groups. A p-value of <0.05 was considered statistically significant.

Results

This double-blind, parallel-group, prospective, randomized clinical study included 117 patients who met the study criteria, among whom 90 agreed to participate. After excluding 15 dropouts, 75 patients were included in the final analysis. The distribution of categorical and continuous variables was analyzed across three groups: Group 1 (first-time cesarean patients), Group 2 (patients with 1-3 previous cesareans sutured with a continuous single-layer non-locking stitch), and Group 3 (patients with 1-3 previous cesareans sutured with a continuous double-layer non-locking stitch) (Tables 1 and 2).

Table 1. Distribution of categorical variables by groups

		Group						p
		Group 1		Group 2		Group 3		
		n	%	n	%	n	%	
Placental localisation	Anterior	3	12.0	11	44.0	8	32.0	**0.001**
	Fundal	15	60.0	6	24.0	2	8.0	
	Posterior	7	28.0	8	32.0	15	60.0	
Gender of the baby	Male	13	52.0	10	40.0	14	56.0	0.500
	Female	12	48.0	15	60.0	11	44.0	
Emergency CS	Yes	18	72.0	7	28.0	13	52.0	**0.008**
	No	7	28.0	18	72.0	12	48.0	
Dilatation (cm)	0	17	68.0	23	92.0	22	88.0	0.100
	≤4	8	32.0	2	8.0	3	12.0	
Fewer	Yes	-	-	2	8.0	3	12.0	0.359
	None	25	100.0	23	92.0	22	88.0	
Uterine position	AF	19	76.0	16	64.0	20	80.0	0.412
	RF	6	24.0	9	36.0	5	20.0	
Intrauterine fluid	Yes	1	4.0	4	16.0	3	12.0	0.518
	None	24	96.0	21	84.0	22	88.0	
Niche area grade	Grade 1	18	72.0	20	80.0	13	52.0	0.213
	Grade 2	3	12.0	1	4.0	6	24.0	
	Grade 3	4	16.0	4	16.0	6	24.0	
Niche area (mm^2)	Grade 1	18	72.0	20	80.0	13	52.0	0.092
	Grade 2+3	7	28.0	5	20.0	12	48.0	
Niche width	Non-wide	19	76.0	19	76.0	16	64.0	0.551
	Wide	6	24.0	6	24.0	9	36.0	
Type of anaesthesia	General anaesthesia	1	4.0	2	8.0	2	8.0	1.000
	Spinal anaesthesia	24	96.0	23	92.0	23	92.0	
Wound discharge in the first 6 weeks postoperatively	Yes	3	12.0	-	-	2	8.0	0.361
	None	22	88.0	25	100.0	23	92.0	

CS: Cesarean section, AF: Anteflex, RF: Retroflex

Among cases with previous CS (Groups 2 and 3), a statistically significant difference was found in the niche area, with Group 3 exhibiting a larger niche area (22.73±29.68 mm^2) compared with Group 2 (12.83±10.35 mm^2, p=0.023). However, no significant differences were observed between the groups in terms of niche base (p=0.091) or preoperative anterior wall myometrial thickness (p=0.620) (Tables 3 and 4).

When examining the distribution of categorical variables based on niche width (wide and not wide), a statistically significant difference was found between groups in terms of uterine position (p<0.05). In contrast, 20.4% of the non-wide niche group had a retroflexed uterus, 42.9% of the wide niche group had a retroflexed uterus (Table 5).

Discussion

Incomplete healing of the cesarean scar is a long-term complication of cesarean delivery and is widely known to be associated with numerous gynecological symptoms[8]. Considering the relationship between uterine niche and gynecological symptoms, obstetric complications, and potential subfertility, it is crucial to clarify the etiology of niche development following cesarean delivery and develop preventative strategies[8]. Our study investigated whether the thickness of the lower segment has predictive value in postoperative niche formation to elucidate the etiology of this frequently occurring condition, which can cause various symptoms, and to develop a new predictive marker for predicting niche formation.

Table 2. Average distribution of continuous variables by groups

	Group 1	Group 2	Group 3	p
	Avg. ± SD	Avg. ± SD	Avg. ± SD	
Age (year)	27.48±6.19	30.96±5.91	31.72±5.31	**0.028**
Gestational week	38.92±1.47	38.32±0.69	38.20±0.71	0.168
Gravida	1.96±1.31	2.88±0.78	3.44±1.42	**0.001**
Parity	0.56±1.08	1.52±0.65	1.76±0.78	**0.001**
Abortion	1.14±0.38	1.29±0.49	2.00±1.83	0.453
Ectopic pregnancy	1.0	-	-	-
Evacuation curettage	1.00	-	1.50±0.71	0.317
Number of old CS	0	1.44±0.65	1.48±0.65	**0.001**
Birth weight (gram)	3259.2±661.7	3368.8±314.05	3213.2±402.92	0.507
BMI (kg/m^2)	31.65±5.09	30.53±4.49	28.99±3.72	0.137
Weight gain in pregnancy (kg)	14.18±5.87	12.36±5.82	10.2±7.85	0.108
Preop WBC (mcL)	10387.2±2284.2	9521.6±1677.9	9689.6±2316.9	0.313
Postop WBC 6h (mcL)	14630.4±3602.9	12515.6±3537.2	13367.2±2696.	**0.042**
Postop WBC 24h (mcL)	12524.8±3153	11151.2±2318.3	11384.8±2483.7	**0.029**
Preop Hb (gr/dL)	12.19±1.27	11.6±1.34	11.21±1.46	0.082
Postop Hb 6h (gr/dL)	11.1±1.2	10.77±1.33	9.89±1.3	0.159
Postop Hb 24h (gr/dL)	10.91±1.23	10.5±1.27	9.86±1.35	**0.004**
preop HTC (%)	37.88±3.52	36.14±3.5	35.1±3.88	**0.018**
Postop HTC 6h (%)	34.54±3.45	34.02±3.4	31.23±3.73	**0.003**
Postop HTC 24h (%)	33.98±3.3	33.2±3.29	30.98±3.69	0.008
Effacement (%)	16.4±27.5	4.4±15.3	2.8±9.8	0.053
Preoperative anterior wall myometrium thickness (mm)	5.49±2.05	4.56±1.42	4.95±2.19	0.266
Endometrial thickness (mm)	3.98±1.96	4.2±2.11	4.86±2.73	0.481
Niche height (mm)	4.28±2.05	3.8±1.57	5.16±2.4	0.088
Niche base (mm)	5.46±2.4	6.16±2.68	7.52±4.13	**0.038**
Residual myometrium thickness (mm)	6.06±2.5	5.08±1.86	5.8±2.19	0.382
Niche area (mm^2)	13.12±11.3	12.83±10.35	22.73±29.68	**0.037**
Niche width (mm)	41.8±14.75	43.17±15.41	46.45±11.82	0.490

CS: Caesarean section, BMI: Body mass index, WBC: White blood cell, Hb: Hemoglobin, HTC: Hematocrit, SD: Standard deviation, Avg.: Average

Our findings indicated no correlation between preoperative anterior wall myometrial thickness and niche size assessed via TVS at 6-8 weeks postoperatively. Previous studies have suggested that incisions made close to the internal cervical os, potentially involving cervical tissue, may impair healing and contribute to scar defects[17]. Bij de Vaate et al.[16] identified low uterine incisions as an independent risk factor for niche development, and Zimmer et al.[18] reported higher niche occurrence following cesarean delivery when the cervix is effaced and incorporated into the uterine wall (17.9±9.4 vs. 14.6±9.1 mm; p=0.01). For this reason, patients with >5 hours of active labor and cervical dilatation exceeding 4 cm were not included in our study.

All participants in our study had anterior wall myometrial thickness measurements above 4 cm, with incisions consistently made at this location, thereby controlling for localization differences in niche development.

Various diagnostic methods have been used to identify the niche. A niche can be visualized through hysterosalpingography, transabdominal sonography, TVS, gel or saline infusion sonography, or hysteroscopy[5,7,19].

Table 3. Distribution of niche area and width ratios by groups for cases with previous CS

		Group 2		Group 3		p
		n	%	n	%	
Niche area	Grade 1	20	80.0	13	52.0	0.118
	Grade 2	1	4.0	6	24.0	
	Grade 3	4	16.0	6	24.0	
Niche width	Not wide	19	76.0	16	64.0	0.355
	Wide	6	24.0	9	36.0	

CS: Cesarean section

Table 4. Average distribution of niche area, niche base, and preoperative anterior wall myometrium thickness by groups for cases with previous CS

	Group 2	Group 3	p
	Mean ± SD	Mean ± SD	
Niche area (mm^2)	12.83±10.35	22.73±29.68	0.023
Niche base (mm)	6.16±2.68	7.52±4.13	0.091
Preoperative anterior wall myometrium thickness (mm)	4.56±1.42	4.95±2.19	0.620

SD: Standard deviation, CS: Cesarean section

There is no consensus on the gold standard method for detecting and measuring a niche[16]. TVS is a non-invasive approach for visualizing scar defects and is extremely sensitive in identifying defects. With the liberal use of TVS, the identification of cesarean scar defects has increased[20,21]. Due to its non-invasive nature, easy accessibility, and low cost, we preferred TVS for our study.

A study by Ofili-Yebovi et al.[20] attempted to assess cesarean scar integrity during pregnancy, but it was found that sonographic detection of uterine scars is easiest outside of pregnancy. Generally, wound healing assessment is performed via ultrasonography 6 weeks post-surgery[17,22]. All patients in our study were also evaluated in the 6-8 weeks postoperative period.

Another theory related to uterine closure involves the decision to lock or not to lock the sutures. Some studies have suggested that single-layer locking could increase tissue hypoxia and inadequate healing, potentially raising the risk of uterine rupture[23]. A study by Yasmin et al.[24] comparing locked and non-locked suturation showed that locking the first layer resulted in decreased myometrial thickness and increased blood loss. In light of these findings, we compared the outcomes of non-locked single- and double-layer uterine suturation in cesarean birth.

Another issue investigated in niche development is the incomplete closure of the uterine wall and the exclusion of the endometrial layer, which leads to disrupted myometrium and niche formation. A prospective cohort study involving 78 patients by Yazicioglu et al.[25] compared single-layer uterine closure, including and excluding the endometrium, and reported less niche development in full-layer uterine closure, including the endometrium (44.7% versus 68.8%); (odds ratio: 2.718; confidence interval: 1.016-7.268). In our study, all patients were continuously sutured to full thickness without locking, including the endometrium. No significant difference was found between the single- and double-layer sutured old cesarean groups in terms of niche base, height, width, and residual myometrial thickness. The niche area was significantly larger in the group with double-layer continuous non-locked suture in old cesarean cases (p=0.023).

Study Limitations

The limitations of our study include the relatively short postoperative period of 6-8 weeks for examining and the limited number of patients, which may have affected the ability to generate symptoms.

Conclusion

Once the decision to perform a cesarean is made, it is important to understand which factors may hinder proper

Table 5. Distribution of categorical variables according to niche width

		Niche width				p
		Not wide		Wide		
		n	%	n	%	
Placental localisation	Anterior	14	25.9	8	38.1	0.410
	Fundal	16	29.6	7	33.3	
	Posterior	24	44.4	6	28.6	
Gender of the baby	Male	24	44.4	13	61.9	0.174
	Female	30	55.6	8	38.1	
Emergency CS	Yes	30	55.6	8	38.1	0.174
	None	24	44.4	13	61.9	
Dilatation (cm)	0	43	79.6	19	90.5	0.330
	≤4	11	20.4	2	9.5	
Fewer	Yes	5	9.3	-	-	0.313
	None	49	90.7	21	100.0	
Uterine position	AF	43	79.6	12	57.1	**0.048**
	RF	11	20.4	9	42.9	
Intrauterine fluid	Yes	6	11.1	2	9.5	1.000
	None	48	88.9	19	90.5	
Type of anaesthesia	General anaesthesia	4	7.4	1	4.8	1.000
	Spinal anaesthesia	50	92.6	20	95.2	
Wound discharge in the first 6 weeks postoperatively	Yes	3	5.6	2	9.5	0.615
	None	51	94.4	19	90.5	

CS: Cesarean section, AF: Anteflex, RF: Retroflex

wound healing to prevent niche formation. Only after proving the efficacy of specific cesarean techniques can we identify the most appropriate method for cesarean delivery and develop suitable training programs. To date, the optimal closure technique for preventing niches and associated symptoms has not been elucidated. Thus, further studies, including randomized controlled trials and long-term follow-ups with structural sonographic evaluations, are required.

Ethics

Ethics Committee Approval: The study was approved by the Ethics Committee of İzmir Katip Çelebi University Atatürk Training and Research Hospital (approval no: 44, date: 25.02.2016).

Informed Consent: This is a prospective, randomized, double-blind, parallel-group study.

Footnotes

Authorship Contributions

Surgical and Medical Practices: R.T., M.Ş., E.D., E.E., S.K., Concept: R.T., S.K., Design: R.T., S.K., Data Collection or Processing: R.T., Analysis or Interpretation: R.T., M.Ş., Literature Search: R.T., Writing: R.T., M.Ş.

Conflict of Interest: No conflict of interest was declared by the authors.

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