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Outcomes of Redo Orchiopexy in Children

Doğuş Güney[1], Ülfet Nihal İrdem Köse[2], Altan Güneş[3], Can İhsan Öztorun[1], Ahmet Ertürk[2], Sabri Demir[2], Fatih Akbıyık[2], Gülsen Keskin[4], Bilge Karabulut[5], Müjdem Nur Azılı[1], Emrah Şenel[1], Tuğrul H Tiryaki[5]

[1]*Yıldırım Beyazıt University Faculty of Medicine, Department of Pediatric Surgery, Ankara, Turkiye*
[2]*Ankara City Hospital Children's Hospital, Clinic of Pediatric Surgery, Ankara, Turkiye*
[3]*Ankara City Hospital Children's Hospital, Clinic of Pediatric Radiology, Ankara, Turkiye*
[4]*Ankara City Hospital Children's Hospital, Clinic of Anesthesiology and Reanimation, Ankara, Turkiye*
[5]*University of Health Science Turkiye, Ankara City Hospital Children's Hospital, Clinic of Pediatric Urology, Ankara, Turkiye*

What's known on the subject? and What does the study add?

Redo orchiopexy for undescended testes after groin surgery is technically challenging and requires skills and care to prevent testicular dysfunction. All reports in the literature about redo orchiopexy's outcomes present differences in the effectiveness of technical procedures. The knowledge of post-redo orchiopexy testicular atrophy in the literature is inadequate. In contrast to the knowledge that "waiting for an elective redo surgery for a minimum of six months is essential." We noted that late operation for recurrent, undescended testes is related to decreased volume. Recurrent undescended testes should be kept in mind for early redo orchiopexy. The reason may be the testes' exposure to high body temperature.

Abstract

Objective: This study aims to evaluate outcomes of redo orchiopexy and the effect of redo surgery timing upon testicular volume.
Materials and Methods: This prospective study involved children receiving redo orchiopexy for recurrent undescended testis. Patients were recruited to assess testicular position, volume, blood flow and presence of microlithiasis. Testis volume was measured by ultrasound and compared with recently developed normative values for testicular size.
Results: A total of 38 patients (40 testes) required redo orchiopexy were reviewed in the study. Thirty three of invited boys could be investigated as long term participation. As a result of long term follow up; 28 of the testes were at scrotum, 2 of them were at inguinal canal and 3 of them were non-palpable, with a 15% failure rate of redo orchiopexy. For all patients evaluated in the control visit mean testis volume was 1.23 mL, at 24 of whom were significantly smaller than the normative values for the same age ($p<0.001$). Eleven of the testes (33.3%) had microlithiasis. The average of duration between primary and redo orchiopexy was 13.5 months in the group of normal volume testes, 23.3 months in the group of significantly smaller testes ($p=0.056$).
Conclusion: The long-term volumes of testes after redo orchiopexy were significantly less than the normative values. Frequent and long time follow up of operated undescended testes and early intervention of recurrent cases may improve outcomes of surgery.
Keywords: Orchiopexy, children, testes

Introduction

Orchiopexy is one of the most common surgical procedures performed in pediatric surgery clinics. Recurrence of undescended testes (UDT) following orchiopexy has been reported to range from 1.8% to 10% (1,2). After groin surgery, redo orchiopexy for UDT is technically challenging, requiring skill and care to prevent testicular dysfunction. All reports in the literature about redo orchiopexy's outcomes present differences in the effectiveness of technical procedures (1-10). The knowledge of postredo orchiopexy testicular atrophy in the literature is inadequate.

International guidelines from the American Urological Association, the British Association of Pediatric Surgeons/

Correspondence: Doğuş Güney MD, Yıldırım Beyazıt University Faculty of Medicine, Department of Pediatric Surgery, Ankara, Turkiye
Phone: +90 530 777 22 85 **E-mail:** dous_caliskan@hotmail.com **ORCID-ID:** orcid.org/0000-0001-7168-2123
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British Association of Urologic Surgeons, the Canadian Urological Association, and the European Association of Urology recommend surgical-specialist referral from primary caregivers if testicular descent does not occur within six months or if the UDT is newly diagnosed after six months (11). Surgical exploration and orchiopexy are recommended between six and 12 months to protect fertility potential and decrease malignant changes (12-14). Histological evidence suggests that orchiopexy should be performed within the first year of life (no later than two years old) to protect fertility (15). However, there is no data about the timing effects of redo surgery in patients with recurrent UDT. Also, the question of when redo orchiopexy should be performed remains unanswered.

We reviewed our 13 years of experience with redo orchiopexy to determine the effects of redo operation timing. Furthermore, this study evaluates the outcomes of redo orchiopexy and reveals factors affecting testicular volume.

Materials and Methods

Study Demographics and Design

This study was approved by the local ethics committee (ref. No. 2019-224). We reviewed the medical records of patients who underwent redo orchiopexy for recurrent UDT in our clinic between 2005 and 2018. Each patient was asked to participate in a long-term evaluation for this prospective study.

Inclusion Criteria

- Patients younger than 18 years old who had been operated on at our hospital for primary orchiopexy;
- Patients younger than 18 years old who had accessible medical records and had been operated on at another center for primary orchiopexy;
- Patients who responded positively to our inquiry about participating in this study.

Exclusion Criteria

- Patients with previous inguinal surgery for other conditions, such as an inguinal hernia or testis torsion;
- Patients who have undergone orchiectomy at the time of the redo-exploration;
- Patients who did not respond to our call for this study.

This study reviewed 38 boys who had undergone redo orchiopexy for recurrent UDT in our clinic. Thirty-three of these boys agreed to participate in this prospective study. The study was performed between April 2019 and June 2019. We evaluated variables, including age, testicular location, and intraoperative testicular morphologic findings from hospital records. We also recorded data on testicular volume and morphology at the time of redo orchiopexy. All participants were seen at a control visit at the outpatient clinic. Informed consent for their participation in this study was provided.

Examination and Definitions

The final testicular location was evaluated by physical examination. Testicular volume, blood flow, and the presence of microlithiasis were evaluated by color Doppler ultrasonography. The testes were classified as scrotal, high scrotal, inguinal, or nonpalpable. The testes' longitudinal, anteroposterior, and transverse diameters were measured, and the testicular volume was calculated (volume=0.523 × D1 × D2 × D3, where D1, D2, and D3 were the maximal longitudinal, anteroposterior, and transverse diameters) expressed in milliliters (mL).

Since the definition of "testicular atrophy" is controversial in the literature, we categorized testicular volume as "smaller than normal values for age" or as "normal." Normal testicular volume values for each age group had been recently published before we reused them as a guide in our study (16). In addition, the volume of the unilateral UDT was compared with the contralateral testis.

Statistical Analysis

All data were collected and analyzed using the Statistical Package for the Social Sciences (SPSS), version 25 (IBM, Chicago, IL) software. For categorical variables, data were compared using chi-square. Normality tests were performed. If the data distributed correlations between the volume measurements were calculated with Pearson's correlation coefficient for normally distributed data and Spearman's correlation for data not distributed normally. The independent samples t-test was used to compare the volumes of the patient's testes with normal values.

Results

From 2005 to 2018, 38 boys underwent redo orchiopexy for recurrent UDT in our clinic. When requested, 33 (86.8%) of these boys gave informed consent to participate in this prospective study.

Characteristics of Primary and Redo Orchiopexy

Primary orchiopexy was performed at 41.82±32.56 months (range: 7-132 months). Primary orchiopexy was performed: right-side in 13 (39.4%) patients; left side in 10 (30.3%) patients; and bilateral in 10 (30.3%) patients. Primary surgery had been performed in our institution in 51.5% of cases (17 patients). The primary surgical procedure was inguinal orchiopexy in 32 patients and scrotal orchiopexy in one patient. During primary orchiopexy, testicular volumes were smaller

than those of the contralateral in six (18.2%) patients with unilateral UDT. According to the operation notes, epididymal-testicular fusion anomalies were noted in four patients (12.1%). The mean duration between the two surgeries was 22.71±20.89 months (range: 6-72 months). For these 33 testes, testicular volume at the time of the redo surgery ranged from 0.05 to 1.65 ml (0.34±0.27 mL), which was less than the normal values reported in the literature (0.76±0.67 mL, p<0.001). Only one patient's volume was 0,05 ml at the time of the redo surgery. Orchiectomy was not performed in this individual due to the good consistency of the testis. The age at the initial operation was not significantly related to testicular volume at the time of the redo surgery (p=0.917). The preoperative testis location was significantly related to testicular volume at the redo surgery (p=0.018) (Table 1).

Findings at Follow up Visit

The mean duration between the redo surgery and the control visit was 33.93±23.25 months (range: 6-96 months). For all patients evaluated in the control visit, the mean testicular volume was 1.23±2.68 mL (range: 0.05-14.67 mL). For the age at the control visit, the normal mean volume was 1.54±2.02 mL and was significantly higher than the patients' mean volume (p<0.001) (16). Also, no correlation was found between participants' testicular volumes and the normal values (p=0.140, r=0.263). Twenty-four (72%) of these 33 patients' testicular volumes were significantly smaller than normative values for the same age patients who had attended the control visit (p<0.001) (Table 2). Nineteen of 24 patients' testicular volume was already smaller at redo orchiopexy, and 11 of 24 patients' lost additional testicular volume during the interval between the redo surgery and the control visit.

Comparing Testicular Volumes with Contralateral for Unilateral Cryptorchidic Patients

Table 1. The relationship between age at primary orchiopexy and testicular volume at the time of the redo surgery, and preoperative testis location and testicular volume at the time of the redo surgery

Normal		Testicular volumes at redo orchiopexy		
		Decreased	p	
Age at primary orchiopexy n (%)	Up to 1 year	2 (28.5)	5 (71.5)	0.917
	1-2 years	3 (33.3)	6 (66.7)	
	2-5 years	2 (25)	6 (75)	
	Older than 5 years	3 (33.3)	6 (66.7)	
Testis location at primary orchiopexy n (%)	Distal canalicular	6 (85.7)	1 (14.3)	0.018
	Proximal canalicular	1 (14.3)	6 (85.7)	
	Internal ring	4 (28.5)	10 (71.5)	
	Intraabdominal	0	5 (100)	

Table 2. Comparison of testicular volumes between patients and normal values expected for age group

Age (years)	n (testis)	Testicular volume (mL) Mean ± SD	
		Participants	Normal values*
2	1	0.10	0.46
3	2	0.35±0.20	0.51
4	3	0.24±0.17	0.51
5	5	0.32±0.13	0.58
6	3	0.66±0.40	0.63
7	3	0.42±0.28	0.65
8	2	0.25±0.07	0.66
9	3	0.57±0.58	0.79
10	2	0.33±0.04	0.97
11	2	0.69±0.07	1.33
12	3	6.95±6.76	2.33
13	3	2.34±2.90	4.42
17	1	2.03	12.12

SD: Standard deviation

An initial orchiopexy was performed on 23 of 33 patients with unilateral UDT. The mean volume of the undescended side was 0.36±0.32 mL (minimum: 0.05 - maximum: 1.65 mL), and the mean volume of the contralateral non-operated side was 0.54±0.36 mL (minimum: 0.15 - maximum: 1.79 mL) on the redo operation date (p=0.002). Fourteen (60%) of these unilateral orchiopexy-performed testicular (n=23) volumes were smaller than the contralateral on the redo operation date. The mean testicular volumes of the operated and contralateral testes were 0.73±0.94 mL (minimum: 0 - maximum: 4.11 ml) and 0.90±1.23 mL (minimum: 0.12 - 1.79 mL), respectively (p=0.149) on the control visit date. Four (17.4%) of these unilateral orchiopexy-performed testicular (n=23) volumes were smaller than the contralateral on the control visit date.

The Effects of the Interval between Primary Orchiopexy and Redo Orchiopexy (Redo Timing) on Testicular Volume

The mean redo operation duration for the testes with decreased volumes (n=24) and normal volumes (n=9) at the control visit was 23.3±21 and 13.5±6.4 months, respectively (p=0.056). During the redo operation period, testicular volumes were lower than normal for 19 of these 24 testes. The participants who lost additional volume between the redo operation and control visit date are the most important for evaluating testicular volume differences. Eleven patients had lost additional volume. All had received a redo operation one year after primary orchiopexy. Also, the ones with normal volumes (n=9) had received a redo operation in the first year of primary orchiopexy (p=0.023) (Table 3).

Blood flow was normal for all participants at the follow-up visit. Microlithiasis was detected in 11 participants. The final locations of the testes: low-scrotal for 22 patients; high scrotal for six patients; inguinal for two patients; and nonpalpable for three patients. The success rate of redo orchiopexy was 85%, defined as the testis is palpable and scrotal.

Table 3. Alteration of mean testicular volume by the time between redo orchiopexy and control visit

	Normal	Decreased	p
Patients who were performed redo operation in the 1st year of primary orchiopexy (n=9) (%)	9 (100)	0	0.023
Patients who were performed redo operation after the 1st year of primary orchiopexy (n=24) (%)	13 (54.2)	11 (45.8)	

Discussion

The main aim of this study was to evaluate long-term testicular volume after redo orchiopexy. Our study demonstrates that the testicular volumes of most patients were significantly smaller than normal values. In addition, we noted that late operation for recurrent UDT is related to decreased volume.

The success rate of orchiopexy repair is approximately 90%, related to preoperative testicular location and surgical technique (17). The incidence of recurrent UDT is approximately 10% after primary inguinal orchiopexy and is usually related to the incomplete dissection of cord structures. Also, failure to perform high ligation of the patent processus vaginalis can lead to primary orchiopexy failure (18). McIntosh et al. (19) presented repeat orchiopexy in 31 boys, resulting in a primary failure

Table 4. Review of nine articles reporting the data of redo orchiopexies

Author	Year	Study population	Redo timing*	Definition of TA**	Findings
Dudley et al. (1)	2010	27 UDT secondary to a previous groin surgery	No information	NI	A scrotal approach to orchiopexy is acceptable and adequate, with favorable results in patients with previous groin surgery.
Lopes et al. (2)	2016	61 children requiring redo orchiopexy	3.7±3.4 years (range: 0.3-13.1 years)	NI	Scrotal and inguinal orchiopexies appear to be viable in the management of secondarily ascending testis, with the scrotal approach offering some advantage in terms of the length of the procedure.
Ziylan et al. (3)	2004	28 children requiring redo orchiopexy	3.2 years (1-13 years)	NI	"En-bloc cord mobilization" yields successful results with minimal risk of complication.
Leung et al. (4)	2005	15 impalpable testes; three redo orchidopexies	No information	NI	Laparoscopic mobilization of testicular vessels is useful in the management of impalpable testis and redo UDT.
Tong et al. (5)	2009	31 patients with previous groin surgery	2.4 years (range: 0.6-4.2 years)	NI	This study highlights the application of laparoscopy in reoperative orchiopexy, strengthening its advantage in this extensive mobilization of testicular vessels to gain additional length.
Karaman et al. (6)	2010	16 children requiring redo orchiopexy	2.4±2.1 years (6 months- 6.2 years)	NI	The transscrotal approach is a fast, simple, and reliable method for redo-procedures for UDT.
Fares et al. (7)	2011	38 children requiring redo orchiopexy	No information	NI	Redo orchiopexy should commence with a high scrotal incision. An additional groin incision should be reserved for those cases where insufficient vascular length is obtained for placement of the testis in the scrotum without tension.
Riquelme et al. (8)	2012	nine children requiring redo orchiopexy	No information	NI	The laparoscopic approach for a failed open conventional orchiopexy represents a feasible and safe option to treat recurrent cryptorchidism.
Sfoungaris et al. (9)	2016	seven children requiring redo orchiopexy	12 months to 11 years (mean 4.4 years)	NI	A combined preperitoneal and inguinal approach can be considered a safe and efficient procedure for redo orchiopexy.

*Period between primary and redo orchiopexies
**TA: Testicular atrophy
***NI: No information, UDT: Udescended testes

rate of 1.6% and a success rate of 86.3%. They concluded that factors that may affect the risk of failure were correlated with bilateral operation and age at the time of the primary operation. Our study evaluated 33 boys who needed redo orchiopexy, and 17 of them had been operated on in a medical center other than our clinic. The success rate of our series was 85%, as in the Mcintosh study (19). However, because many participant patients operated on in other centers, evaluating the factors that affect primary orchiopexy failure was not our goal.

The orchidometer is known to overestimate testicular volume because it measures the epididymis and the scrotal skin. Therefore, ultrasonography is more precise (20). Although several studies comparing the orchidometer and ultrasound have found that both methods correlate well, we prefer ultrasound parameters because they are more reliable (21,22). Scrotal ultrasound shows the best sensitivity to testicular volume measurement. It also evaluates testicular echo structure and its echo tessiture, both of which reflect testicular health. For instance, the occurrence of testicular microlithiasis (defined as the presence of about five hyperechoic, intratesticular spots) at the pediatric age has been associated with a higher risk of developing testicular tumors, cryptorchidism, and infertility (23). Testicular microlithiasis was present in 11 of 33 patients in our study group. Long-term follow-up is planned for all patients.

The most published articles about redo orchiopexy consider surgical techniques and present the outcomes of these techniques (Table 4). Also, the definition of testicular atrophy can be confusing in the literature. Tseng et al. defined testicular atrophy as a volume loss of ≥50% after orchiopexy and assessed testicular volume accurately using ultrasonography (17). Ein et al. (24) defined testicular atrophy as a decrease in testicular size by one-third or more than the contralateral testicle. Testicular atrophy was defined as a >50% loss of testicular volume or a postoperative testicular volume of <25% of the contralateral testis by Durell et al. (25). The preoperative testis location was significantly related to the testicular volume at the time of the redo surgery.

Twenty-four (72%) of 33 patients' testicular volumes were significantly smaller than normative values at the control visit. Eleven patients (45.8%) lost testicular volume after the redo surgery. Eleven patients were those operated on for redo surgery after one year of primary orchiopexy. In support of the literature, the blood supply of all testes, even if small, was normal, as determined by Doppler ultrasound (26). To our knowledge, this is the first study that describes the relationship between testicular volume and the timing of redo orchiopexy for recurrent UDT.

Recurrent cryptorchidism requires that a planned, second-stage procedure be undertaken within six months. Recurrent cryptorchidism noted during a follow-up of the initial procedure can be electively repaired at that time. In several studies, the mean time between the initial surgery and the operation for failed orchiopexy ranged from 0.3 to 13 years (1-9). After orchiopexy, the size of the testis should be assessed to determine whether testicular growth has occurred. Although most testes will grow normally after orchiopexy, some may have growth retardation, atrophy, or involute altogether (27). Ein et al. (24) observed that the most severe postoperative complication of testis atrophy occurred within three months because the minimum time for a follow-up was at least three months.

There is a lack of observations regarding the effects of redo orchiopexy timing on testicular volume in the literature. In contrast, it is known that "waiting for an elective redo surgery for a minimum of six months is essential." Recurrent UDT should be kept in mind for early redo orchiopexy. The reason may be because of the testes' exposure to high body temperature. However, the increased likelihood of testis loss due to adhesion in the cord should be considered for the early reoperated patients.

Study Limitations

This study has limitations. Thirty-three of the 38 patients who underwent redo orchiopexy for recurrent UDT in our clinic participated in this study. Missing information and logistical problems were the reasons for their nonparticipation. The small number of patients decreases this study's significance. In addition, some patients' duration between orchiopexies was very long. This condition decreases the power of the statistical analyses of the redo-timing parameter.

We used the normative values of testicular volumes in healthy boys up to adolescence for comparison, although testicular volumes varied with geographic area, ethnicity, environmental factors, and dietary conditions (16). Furthermore, hormone levels were not evaluated, and a semen analysis was not performed. Randomized controlled prospective studies are needed to evaluate the effects that redo orchiopexy timing has on testicular volume.

Conclusion

Redo orchiopexy is a safe, surgical procedure that can be performed with a high success rate as was shown in our study 85% success. The decrease in testicular volume was related to the testicle's location before primary orchiopexy in long-term follow-ups. No relationship between the age of the first operation and testicular volume was found in our study. All patients with a decrease in testicular volume were reoperated more than one year after primary orchiopexy. This suggests that

testicular volume may be affected by the period between initial orchiopexy and redo orchiopexy.

Ethics

Ethics Committee Approval: This study was approved by the local ethics committee (ref. no. 2019-224).

Informed Consent: Informed consent for their participation in this study was provided.

Peer-review: Externally and internally peer-reviewed.

Authorship Contributions

Surgical and Medical Practices: A.E., F.A., Concept: A.E., S.D., E.Ş., Design: A.G., G.K., T.H.T.,

Data Collection or Processing: D.G., Ü.N.İ.K., B.K., Analysis or Interpretation: C.İ.Ö., M.N.A., Literature Search: D.G., T.H.T., Writing: D.G., T.H.T.

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