Radiology

Evaluation of Testicular Volume in Children Aged 6-36 Months with Cryptorchidism: A Retrospective Ultrasonographic Study

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ABSTRACT

Background: Cryptorchidism, defined as the failure of the testes to descend into the scrotum, is a common condition in male children. The authors aimed to assess the testicular volume in children of different ages with cryptorchidism and to investigate its potential effects on testicular development.

Methods: This retrospective study was approved by the institutional ethics committee. The study included 480 patients with abnormal scrotal ultrasonography findings and 67 control cases between January 2024 and January 2025. Testicular volume was calculated. Measurements were conducted by a pediatric radiologist with at least 10 years of experience.

Results: The mean age of the enrolled male children was 21 months. A significant difference was observed between right testicular volumes (0.24 ± 0.1) and left testicular volumes (0.27 ± 0.13) in patients with right cryptorchidism ($t = -4.568$; $P < .001$). Similarly, there was a significant difference between right testicular volumes (0.26 ± 0.12) and left testicular volumes (0.23 ± 0.09) in patients with left-sided cryptorchidism ($t = 4.661$; $P < .001$). There were statistically significant differences in testicular volumes according to age groups in patients with cryptorchidism, hydrocele, and descended testis ($F = 3.216$; $P = .013$, $F = 3.428$; $P = .013$, $F = 26.135$; $P < .001$, respectively).

Conclusion: Testicular volumes in males under 3 years with cryptorchidism are significantly smaller than in healthy children.

Keywords: Cryptorchidism, ultrasonography, testicular volume, undescended testes, pediatric radiology

Introduction

Cryptorchidism, defined as the failure of the testes to descend into the scrotum, is a common condition in male children.[1] Low birth weight, advanced maternal age, and prematurity are among the risk factors.[2] It occurs in 1-4% of term infants and up to 30% in preterm infants,[3] while it can be observed in 60-70% of low birth weight infants.[4] In undescended testes, both reduced volume and impaired reproductive function may be observed.[5-7]Normally, testicular descent into the scrotum occurs during the gestational period, between 3 months and 6 months of age. Bilateral involvement is seen in 15-20% of cases, and it is more commonly unilateral, slightly favoring the right side.[8]

Cryptorchidism was first described by Hunter in 1786, and many studies have been conducted on the topic since then. It has been shown to impair testicular development and spermatogenesis, as well as significantly increase the risk of malignancy.[9,10] However, studies evaluating the impact of cryptorchidism on testicular volume in early childhood remain limited. In this study, the authors aimed to assess the testicular volume in children of different ages with cryptorchidism and to investigate its potential effects.

Material and Methods

Study Protocol

This retrospective study was approved by the Ethics Committee of Gaziantep City Hospital under decision number 194/2025, dated 21/05/2025 and informed consent was waived. The

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study included 480 patients with abnormal scrotal ultrasonography findings and 67 control cases between January 2024 and January 2025. The control group consisted of children aged 6-36 months who were referred for scrotal ultrasonography due to non-testicular reasons (such as suspected inguinal hernia or abdominal pain) and were confirmed to have bilaterally normal descended testes with no history of urogenital disease, surgery, or systemic conditions affecting the testes. Inclusion criteria: ages 6-36 months, presence of undescended testis, retractile testis, or hydrocele. Exclusion criteria: history of hypospadias, testicular mass or surgery, and testis-affecting systemic diseases. The children were divided into 5 age groups for analysis: Group 1: 6-12 months, Group 2: 13-18 months, Group 3: 19-24 months, Group 4: 25-30 months, and Group 5: 31-36 months. Cases were classified into three subgroups: cryptorchidism (unilateral or bilateral undescended testis), retractile testis, and testis with hydrocele.

Ultrasonography Measurements

Scrotal ultrasound was performed using the Affiniti 50 (Philips Healthcare, The Netherlands) system with an L12-5 linear transducer. Measurements were conducted by a pediatric radiologist with at least 10 years of experience. Testicular volume was calculated in cubic centimeters (cc) using the formula 0.523 × length × width × thickness (Figure 1).

Statistical Analysis

Statistical analyses were performed using the SPSS (Statistical Package for Social Sciences for Windows) version 27.0 software (IBM SPSS Corp.; Armonk, NY, USA). Descriptive statistics for continuous variables are presented as mean and SD, while categorical data are expressed as frequency and percentage. The normality of quantitative data was assessed using skewness and kurtosis values. For comparisons of continuous variables, independent samples *t*-test and one-way ANOVA were employed. The Chi-square test was used to examine the relationships between categorical variables.

Main Points

- Testicular volumes in males under 3 years with cryptorchidism are significantly smaller than in healthy children.
- No significant compensatory hypertrophy was observed in the contralateral descended testis of children with unilateral cryptorchidism.
- Hydrocele-affected testes showed reduced volumes compared to normal populations, though the difference was not statistically significant.

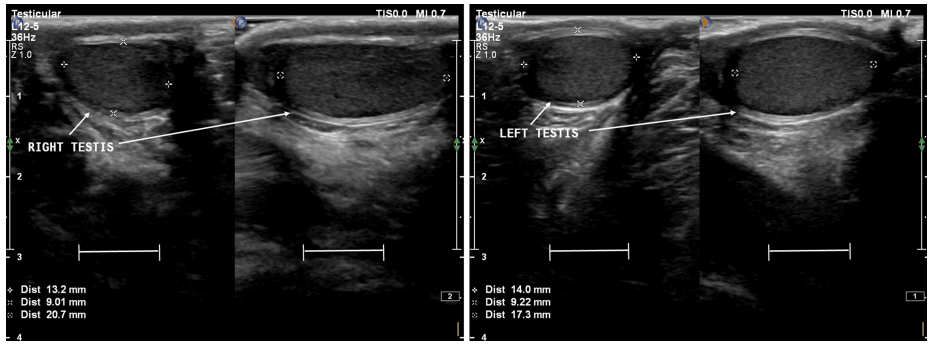

Figure 1. In a 36-month-old boy, the testicular volumes were measured as 1.22 cc on the right and 1.12 cc on the left. Both testes were in the scrotum.

Results

The mean age of the enrolled male children was 21 months (range: 6-36 months). Table 1 presents the age distribution of the patient and control groups included in the study.

The comparison of testicular volumes in patients with cryptorchidism is presented in Table 2. A statistically significant difference was observed between right testicular volumes and left testicular volumes in patients with right-sided cryptorchidism ($P < .001$). Similarly, there was a statistically significant difference between right testicular volumes and left testicular volumes in patients with left-sided cryptorchidism ($P < .001$). The comparison of testicular volumes in children with and without cryptorchidism is presented in Table 3. In cases of unilateral cryptorchidism, the testicular volume of the undescended testis is significantly smaller than that of the contralateral normally descended testis ($P < .001$).

When patients with unilateral cryptorchidism were compared with the control group, a significant difference was observed between the volumes of the undescended testes and the ipsilateral normally descended testes ($P < .001$). However, no significant difference was found when the volumes of the contralateral descended testes were compared with the corresponding testicular volumes in the control group ($P > .05$).

In bilateral cryptorchidism, testicular volumes were also significantly smaller when compared with the ipsilateral testicular volumes of the control group ($P < .001$).

Table 4 presents a comparison of testicular volumes based on age and different groups. When analyzed according to age groups, testicular volumes showed significant differences across all subgroups ($P < .001$). In the 6-12-month group, undescended testes had the smallest mean volume, which was significantly lower than mobile testes, testes with hydrocele, and normally descended testes ($P < .001$). Similar differences persisted in the 13-18-month group, where undescended testes were markedly smaller compared with hydrocele-affected, mobile, and descended testes ($P < .001$).

In older children, this pattern remained consistent. In the 25-30-month group, undescended testes

Table 1. Distribution of Patients with Scrotal Abnormalities and Controls Across Age Groups

Age	Total Sample, n (%)	Patient Group, n (%)	Control Group, n (%)
6-12 month	134 (24.5)	116 (24.17)	18 (26.87)
13-18 month	111 (20.29)	98 (20.42)	13 (19.4)
19-24 month	86 (15.72)	79 (16.46)	7 (10.45)
25-30 month	92 (16.82)	83 (17.29)	9 (13.43)
31-36 month	124 (22.67)	104 (21.67)	20 (29.85)

Table 2. Comparison of Testicular Volumes in Right- and Left-sided Cryptorchidism

	Testes Side	Mean Volume (cc) ± SD	*t*	*P*
Right Cryptorchidism (n = 338)	Right	0.24 ± 0.10	**−4.568***	**< .001***
	Left	0.27 ± 0.13		
Left Cryptorchidism (n = 310)	Right	0.26 ± 0.12	**4.661***	**< .001***
	Left	0.23 ± 0.09		

Bold type was used to indicate statistically significant values. $P < .05$.
*t: paired samples *t*-test.

Table 3. Comparison of Testicular Volumes According to Different Conditions

Condition	Testes Side	Mean Volume (cc) ± SD	Comparison	Mean Volume (cc) ± SD	*t*	*P*
Right Cryptorchidism (n = 338)	Right	0.24 ± 0.10	Left Descended Testes (n = 179)	0.41 ± 0.14	**12.045***	**< .001***
	Left	0.27 ± 0.13		0.39 ± 0.14	**−8.243***	**< .001***
Left Cryptorchidism (n = 310)	Right	0.26 ± 0.12	Right Descended Testes (n = 179)	0.41 ± 0.14	**11.080***	**< .001***
	Left	0.23 ± 0.09		0.39 ± 0.14	**13.739***	**< .001***
Right Cryptorchidism, Left Descended (n = 58)	Right	0.25 ± 0.11	Control (n = 67)	0.44 ± 0.15	**−8.445***	**< .001***
	Left	0.46 ± 0.12		0.47 ± 0.14	−0.361	.719
Left Cryptorchidism, Right Descended (n = 30)	Right	0.44 ± 0.13		0.44 ± 0.15	0.097	.923
	Left	0.21 ± 0.09		0.47 ± 0.14	**10.817***	**< .001***
Bilateral Cryptorchidism (n = 280)	Right	0.24 ± 0.10		0.44 ± 0.15	**10.556***	**< .001***
	Left	0.23 ± 0.09		0.47 ± 0.14	**13.401***	**< .001***
Right Cryptorchidism (n = 338)	Right	0.24 ± 0.10		0.44 ± 0.15	**10.561***	**< .001***
Left Cryptorchidism (n = 310)	Left	0.23 ± 0.09		0.47 ± 0.14	**13.575***	**< .001***
Affected Side of Right Cryptorchidism (n = 58)	–	0.24 ± 0.11	Affected Side of Left Cryptorchidism (n = 30)	0.21 ± 0.09	1.681	.095
Opposite Side of Right Cryptorchidism (n = 58)	–	0.46 ± 0.12	Opposite Side of Left Cryptorchidism (n = 30)	0.44 ± 0.13	0.734	.465

P < .05.
*t, independent samples *t*-test.

Table 4. Comparison of Testicular Volumes According to Age and Groups

Age (months)	Undescended Testes Mean Volume (cc) ± SD (a) (n = 610)	Mobile Testes Mean Volume (cc) ± SD (b) (n = 27)	Testes with Hydrocele Mean Volume (cc) ± SD (c) (n = 68)	Descended Testes Mean Volume (cc) ± SD (d) (n = 389)	*F*	*P*
6-12 (e) (n = 268)	0.22 ± 0.06 (n = 127)	0.42 ± 0.16 (n = 5)	0.3 ± 0.09 (n = 23)	0.36 ± 0.11 (n = 113)	**48.790***	**< .001*** **P^{ab} < .001** **P^{ac} < .001** **P^{ad} < .001** **P^{bc} = .007**
13-18 (f) (n = 222)	0.24 ± 0.1 (n = 142)	0.4 ± 0.07 (n = 7)	0.41 ± 0.14 (n = 7)	0.41 ± 0.12 (n = 66)	**44.535***	**< .001*** **P^{ab} < .001** **P^{ac} < .001** **P^{ad} < .001**
19-24 (g) (n = 172)	0.23 ± 0.09 (n = 105)	0.37 ± 0.1 (n = 9)	0.36 ± 0.1 (n = 8)	0.39 ± 0.12 (n = 50)	**34.725***	**< .001*** **P^{ab} < .001** **P^{ac} < .001** **P^{ad} < .001**
25-30 (h) (n = 184)	0.21 ± 0.09 (n = 105)	- (n = 1)	0.29 ± 0.11 (n = 14)	0.45 ± 0.12 (n = 64)	**109.364***	**< .001*** **P^{ac} < .001** **P^{ad} < .001** **P^{cd} = .011**
31-36 (i) (n = 248)	0.25 ± 0.12 (n = 131)	0.5 ± 0.17 (n = 5)	0.41 ± 0.14 (n = 16)	0.53 ± 0.17 (n = 96)	**74.231***	**<.001*** **P^{ab} < .001** **P^{ac} < .001** **P^{ad} < .001**
F	**3.216***	1.251	**3.428***	**26.135***		
p	**0.013*** **P^{ei} = .005** **P^{hi} = .003**	0.315	**0.013*** **P^{ei} = .005**	**< .001*** **P^{eh} < .001** **P^{ei} < .001** **P^{fi} < .001** **P^{gi} < .001** **P^{hi} < .001**		

P < .05.
*F, one-way ANOVA test.

demonstrated significantly reduced volumes compared with descended testes (*P* < .001). Similarly, in the 31-36-month group, undescended testes had significantly smaller volumes than mobile, hydrocele, and descended testes (*P* < .001).

Across all age categories, a progressive increase in testicular volume with age was observed for normally descended testes (*P* < .001), while testes with cryptorchidism also showed age-related volume increases but at a significantly lower growth trajectory (*P* = .013). In contrast, retractile testes did not show significant age-related volume changes (*P* = .315).

Discussion

Degenerative changes in undescended testes become evident after the age of 2, and infertility rates increase, especially if descent does not occur before age 1.[11] During development, the testes must be in a thermally optimal environment; undescended testes are exposed to inappropriate and unstable temperatures, disrupting spermatogenesis.[12] Mieusset et al[13] proposed that elevated temperature impairs testicular function.

Generally, undescended testes have smaller volumes than normally descended ones (Figure 2). Kollin et al[6] reported testicular volumes of 0.36 mL in undescended and 0.53 mL in descended testes in 6-month-old infants. In this study, the mean volume in cryptorchidism was 0.29 mL, compared to 0.45 mL in normal testes.

Authors' findings confirm that undescended testes have significantly smaller volumes than normally descended ones, in line with previous studies.[5,8] In their randomized study with 16 years of follow-up, Kollin et al[14] demonstrated that orchidopexy performed at 9 months of age resulted in better testicular growth compared to surgery performed at 36 months, highlighting the clinical relevance of this data showing reduced volumes in children younger than 3 years. Liu et al[15] recently established updated normative reference values for childhood testicular volumes, which support the authors' control group findings and validate the reliability of the authors' comparative analyses.

Since the majority of testicular mass consists of spermatogenic tubules, volume is closely related to spermatogenesis. Accurate volume measurement is therefore crucial to understanding functional capacity.[16-18] Ultrasound is the gold standard for measuring testicular volume and also provides information on structure and vascularity.[19]

In this study, the authors compared cryptorchid testes to normal testes in 6-36-month-old children. No significant differences were found between the healthy contralateral testis and the corresponding testis in healthy children, suggesting no compensatory hypertrophy. Hu et al[8] also demonstrated reduced testicular volumes in cryptorchidism without evidence of contralateral hypertrophy, a finding consistent with the authors' results. However, further studies with older children are needed to confirm this observation.

The spontaneous descent of undescended testes is rare after 6 months, and orchidopexy is recommended between 6-18 months.[20] Kollin et al[21] found that testicular volume at age 4 was larger in children who underwent orchidopexy at 9 months compared to those treated at 36 months. Furthermore, normal sperm counts were found in 76% of bilateral cryptorchidism cases treated between 10 months and 36 months, whereas this figure dropped to 26% when treated between 4 years and 14 years.[22,23]

Hydrocele is a common cause of painless scrotal swelling in infants. In this study, hydrocele-affected testes showed reduced volumes compared to normal populations, though the difference was not statistically significant. This finding is consistent with results from Jedrzejewski et al.[24]

An important novel contribution of this study is the large sample size of children under 3 years of age, evaluated by a single experienced pediatric radiologist using standardized ultrasonographic methods. In a similar study in the literature, Hu et al[8] evaluated 424 children aged 0-4 years with unilateral cryptorchidism or normal controls. In contrast, this study focused specifically on a narrower and clinically critical age range (6-36 months), which corresponds to the recommended window for spontaneous testicular descent and the optimal timing for orchidopexy. By restricting the age range, the authors minimized confounding factors related to pubertal testicular growth and provided a clearer assessment of early-life testicular development. This study strengthens the evidence that volume reduction in undescended testes occurs early and persists across all age categories. Moreover, no compensatory hypertrophy was observed in the contralateral-descended testis, confirming that unilateral cryptorchidism does not result in adaptive growth of the normally descended testis during this early period.

From a clinical perspective, the results of this study underscore the importance of timely orchidopexy before 18 months. Given that volume impairment is already evident in the first years of life, delaying surgical correction may further compromise testicular development and future fertility. This data support current guidelines recommending early intervention to preserve testicular growth potential and reduce the risk of malignancy.

Limitations

This study has some limitations. First, it was a single-center retrospective study, so follow-up was not feasible. Second, the study population was not homogeneously distributed, which limited the statistical robustness. Third, although all measurements were performed by a single experienced pediatric radiologist to minimize observer-dependent variability, this approach did not allow the authors to assess interobserver variability. Nevertheless, Liu et al[15] reported excellent interobserver and intraobserver agreement in sonographic measurements of testicular volume.

This study demonstrated that testicular volumes in males under 3 years with cryptorchidism are significantly smaller than in healthy controls. Timely surgical intervention is crucial to prevent future testicular dysfunction and reduce oncogenic risks. Additionally, considering the thermal effects on testicular function, further studies in larger cohorts from various climates are warranted.

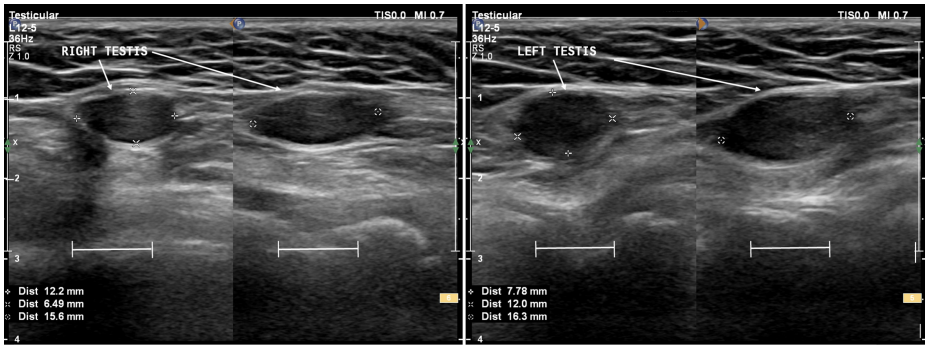

Figure 2. Bilateral undescended testes in a 29-month-old boy. The volumes were measured as 0.64 cc on the right and 0.80 cc on the left.

Data Availability Statement: The data that support the findings of this study are available on request from the corresponding author.

Ethics Committee Approval: Ethical committee approval was received from the Ethics Committee of Gaziantep City Hospital (Approval no: 194/2025, Date: 21.05.2025).

Informed Consent: N/A.

Peer-review: Externally peer reviewed.

Author Contributions: Concept – O.K., M.K., E.C., R.B.P.; Design – O.K.; Supervision – R.B.P.; Resources – E.C., R.B.P.; Data Collection and/or Processing – O.K., M.K., E.C., R.B.P.; Analysis and/or Interpretation – O.K.; Literature Search – O.K., M.K., E.C., R.B.P.; Writing Manuscript – O.K., M.K., E.C., R.B.P.; Critical Review – O.K., M.K., E.C., R.B.P.

Declaration of Interests: The authors have no conflict of interest to declare.

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