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Research Article

Postoperative Testicular Volumes in Adolescents After Laparoscopic-Assisted Orchiopexy

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Abstract

Purpose: Studies have suggested the benefits of early surgery for cryptorchidism. However, few studies have described long-term results. We aimed to evaluate the long-term outcomes of adolescents who underwent laparoscopic-assisted orchiopexy for cryptorchidism.

Methods: Patients who underwent orchiopexy for unilateral maldescended testes between April 2003 and December 2023 were included. The testicular volume was calculated at the outpatient clinic as well as before and after surgery, using ultrasound sonography.

Results: Sixty-two patients were included and divided into eight groups based on their age at surgery. Their ages at the last visit ranged from 10.75 to 16.57 years. The ratio of testicular volume on the affected side before surgery was compared to that after surgery. A significant difference was observed between the 1-2 ($p=0.07$) and 2-3 ($p<0.05$) age groups. The average postoperative testicular volume for those over 10 years old was 6.56 mL, which was lower than that reported by others.

Conclusion: Our results suggest that surgery should be performed between the ages of 1 and 3 years, as recommended by the guidelines. The postoperative testicular volume was lower than the average value for the age group. A combination of additional surgical findings, blood tests for hormones and other secondary sexual characteristics should be considered.

Keywords: Cryptorchidism; Maldescended Testis; Laparoscopic-Assisted Orchiopexy; Testicular Volume, Adolescent and Young Adult

Introduction

Regarding the optimal timing of surgery for cryptorchidism, reports on histological changes in the testis and fertility have suggested that early surgery is advantageous [1-3]. However, these reports describe only the results during early childhood and few reports have described long-term results. An increase in testicular volume during adolescence may indicate testicular function and fertility. At our hospital, we have been performing laparoscopic-assisted orchiopexy for cryptorchidism since the late 1990s, with a postoperative follow-up period of approximately 16 years. This study aimed to examine the long-term results, including the testicular location and testicular volume, of patients who could be followed up after undergoing laparoscopic-assisted orchiopexy.

Methodology

Laparoscopic-assisted orchiopexy was performed on 135 patients in our department between April 2003 and December 2023. Of the 135 patients with laparoscopic-assisted orchiopexy, 24 were excluded from this study, including seven patients with testicular elevation after inguinal hernia/scrotal hydrocele surgery, five patients with re-elevation after orchiopexy, three patients with

testicular fixation after testicular torsion surgery, three patients with atrophic orchiectomy and six patients with metachronous orchiopexy (three with groin incision, two with left varicocele ligation and one with orchiopexy performed at another hospital). In addition, patients with bilateral orchiopexy, chromosomal abnormalities, diaphragmatic hernia or insufficient data were excluded. Patients were divided into eight groups according to their age at surgery: <1, 1-2, 2-3, 3-4, 4-5, 5-6, 6-10 and >10 years.

The surgical method was as follows. A 3-mm port was inserted into the umbilicus to observe the vas deferens and laparoscopically detect intraperitoneal testes. Subsequently, a high scrotal skin incision was made using the Bianchi and Squire method and a subdartos pouch was created [4]. The testicle approached through the fascia and the vas deferens was mobilized. If the testicle is still in a high position, dissection continues towards the external ring. After the positions of the vas deferens and epididymis were confirmed, the testis was fixed in the pocket created in the dartos fascia of the scrotum (Fig. 1). The testicular volume was calculated at the outpatient clinic and after surgery using an approximation of the volume of an ellipse.

Ultrasound sonography was performed by two male engineers and examined by three pediatric surgeons using ALOKA ARIETTA 850 (HITACHI Co., Ltd., Tokyo, Japan), Aplio I900 (Canon Co., Ltd., Tokyo, Japan), Aplio500 (Canon Co., Ltd.) or Affiniti 70G (Philips Co., Ltd., Amsterdam, the Netherlands) machines.

The Kruskal-Wallis test was used to compare groups. All statistical analyses were performed in Microsoft Excel (Microsoft Corp., Redmond, WA, USA).

Results

Sixty-two patients were included in this study (42 on the left side and 20 on the right side) (Table 1). One case was an intraperitoneal testis and the others were located in the inguinal canal. The ages of the patients at the last visit ranged from 10.75 to 16.57 years.

The preoperative testicular volume divided by age at the time of surgery, is shown in Fig. 2. There was no significant difference in preoperative testicular volume between the groups. Patients who underwent surgery in the group older than 10 years of age tended to have smaller testicular volume, but the postoperative testicular volume divided by age at the time of surgery did not differ significantly between the groups (Fig. 3). No difference was observed in the ratio of the testis volume on the affected side to that on the healthy side before and after surgery (data not shown). However, when calculating the ratios of the testicular volume on the affected side after surgery to that before surgery, a significant difference in the ratios was observed between the 1-2-year-old group ($p = 0.07$) and the 2-3-year-old group ($p < 0.05$) (Fig. 4). The number of cases in the group of children under one year old was too small to be useful for reference.

Furthermore, when comparing the postoperative testicular volumes of these groups on the affected and healthy sides to the average testicular volumes by age groups in Japan (Fig. 5). The average postoperative testicular volumes of patient older than 11.5 years in our study were lower than Japanese average testicular volumes. In our patients, the testicular volume on the healthy side was larger than that on the affected side, but the volume on the healthy side was smaller than that of Japan. The testicular volume in the group operated on before the age of 3 years was larger than that in all operated patients but also smaller than the average value determined by Japanese data.

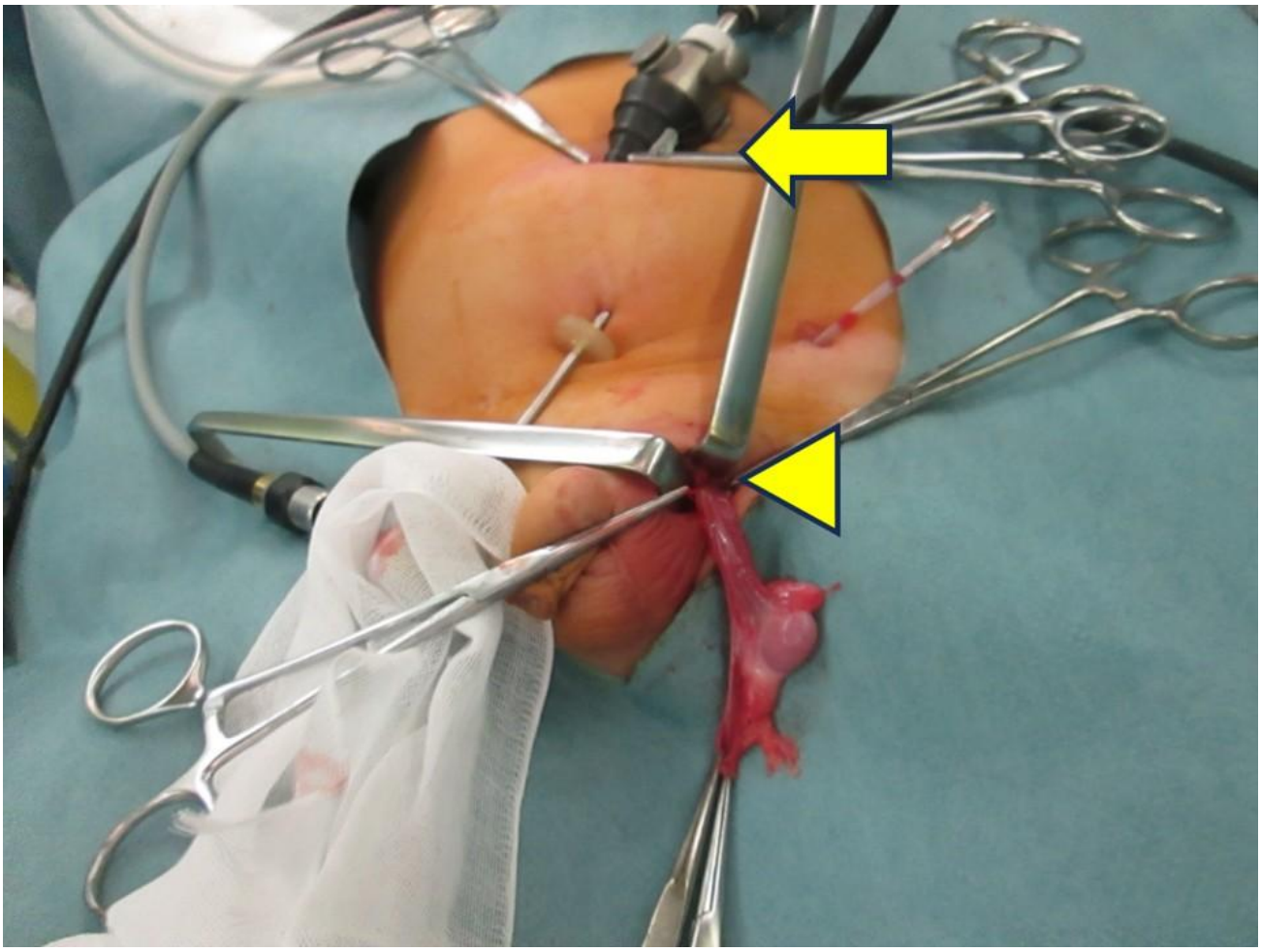

Figure 1: Overview of laparoscopic-assisted orchiopexy. A 3-mm port (arrow) is inserted into the umbilicus and the testes or vas deferens are observed laparoscopically. A high scrotal skin incision (arrowhead) was created and a subdartos pouch was made. After confirming the positions of the vas deferens and epididymis, the testis was fixed to the scrotum.

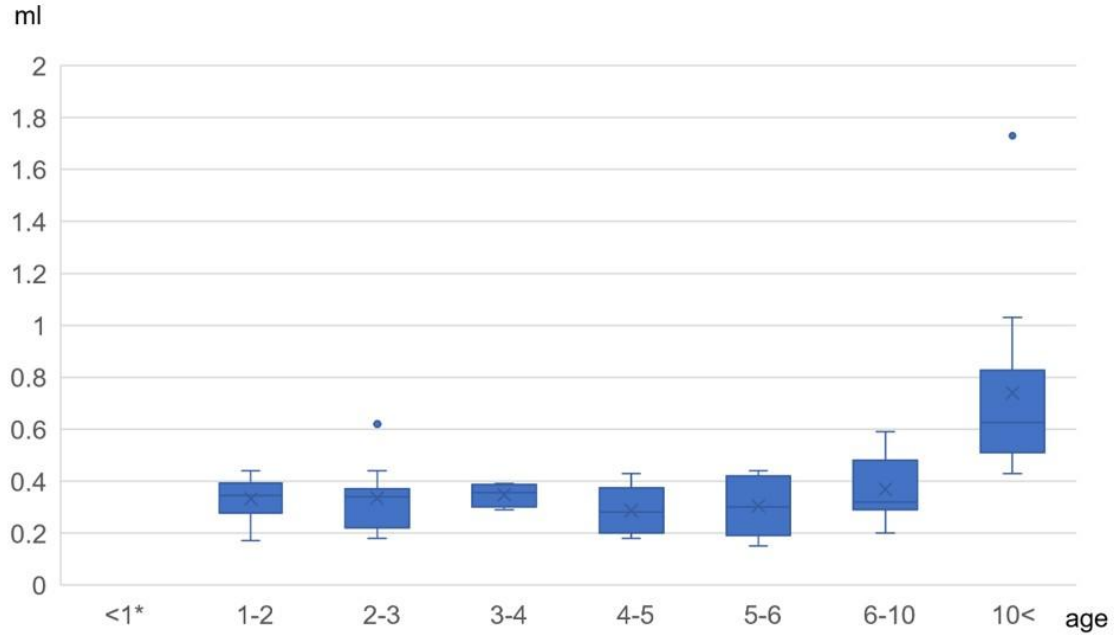

Figure 2: Preoperative testicular volume divided by age at surgery. *Data on the preoperative testicular volume of patients aged <1 year were insufficient.

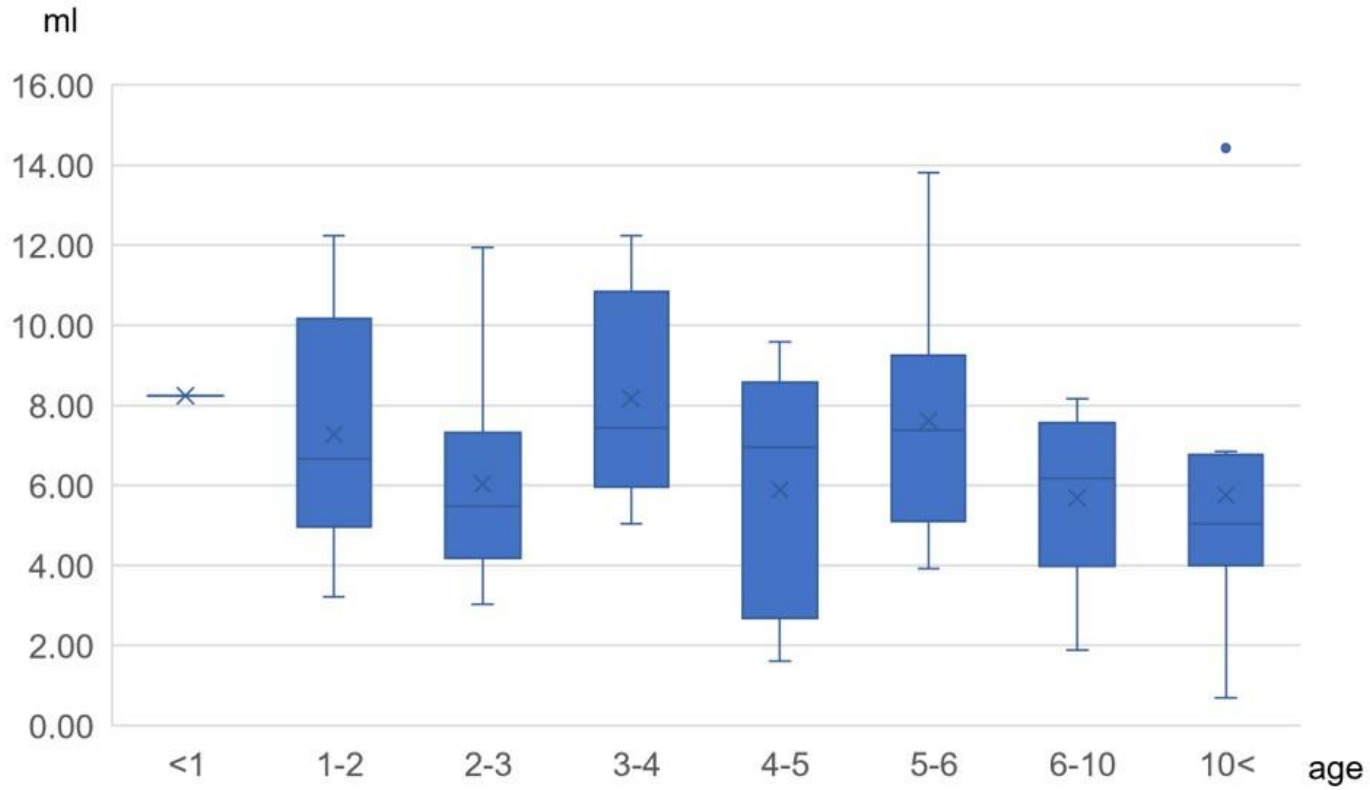

Figure 3: Postoperative testicular volume divided by age at surgery.

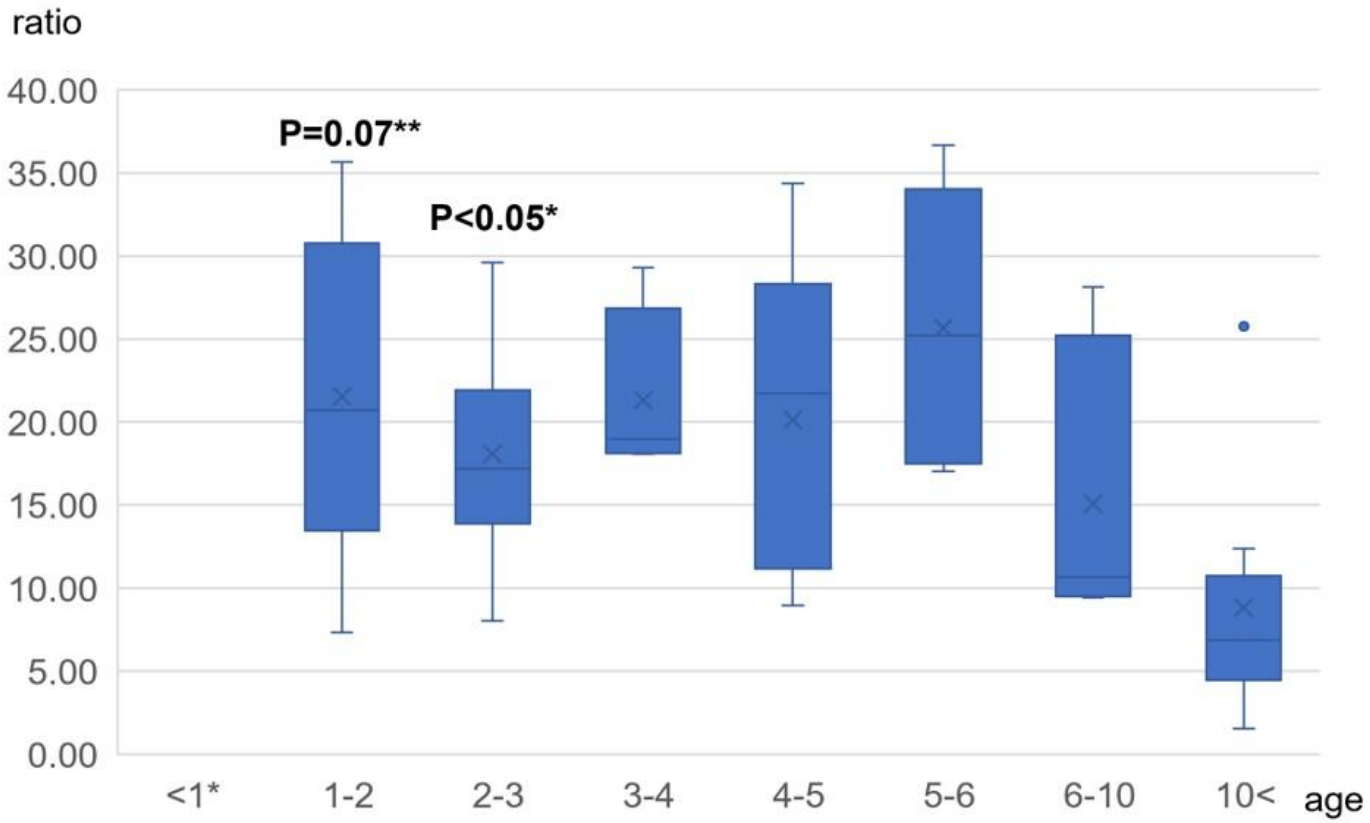

Figure 4: Ratio of the testicular volume after surgery to before surgery. Due to insufficient data on the testicular volume of patients aged <1 year, the ratio of the testicular volume after surgery to that before surgery could not be calculated in this age group.

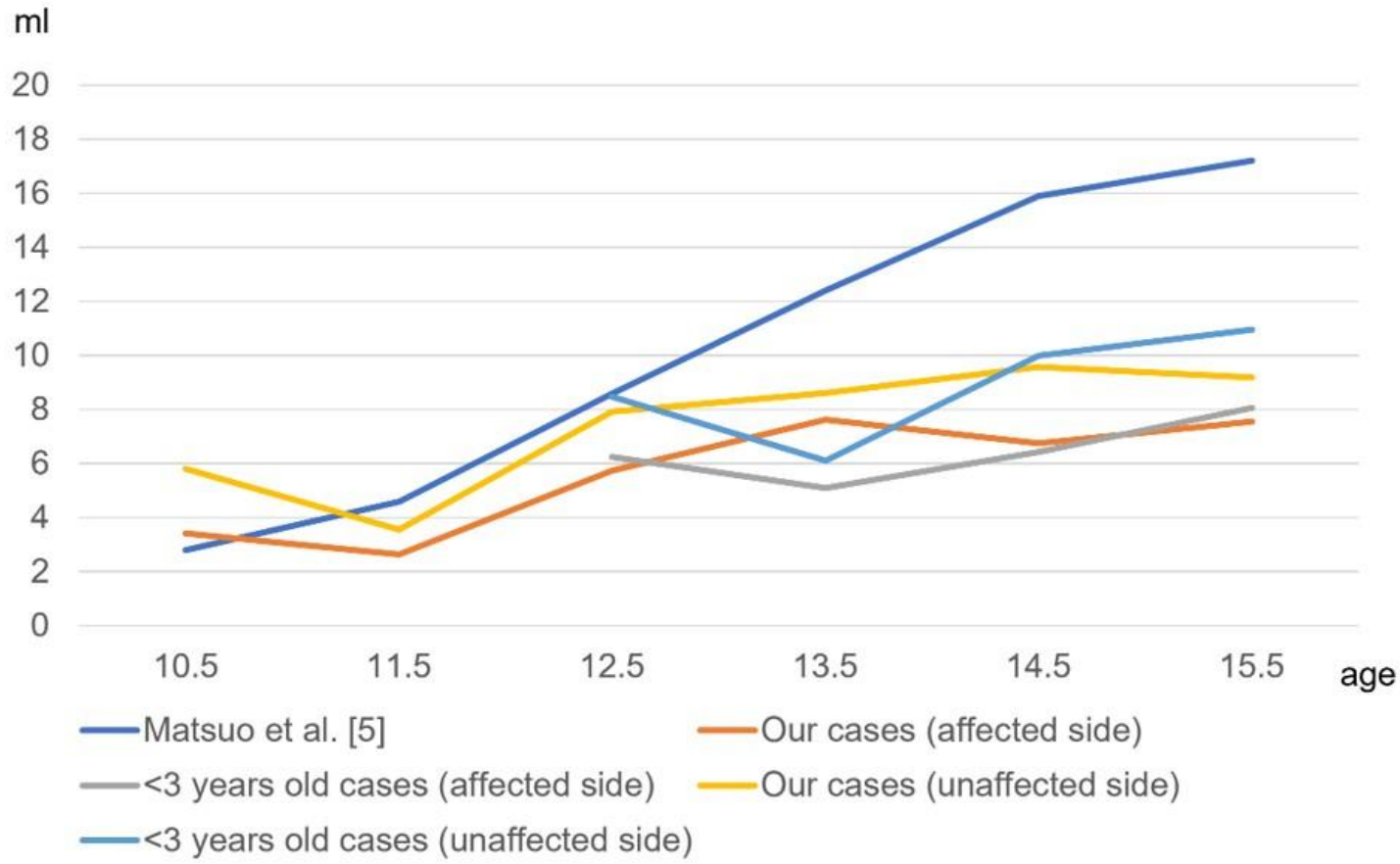

Figure 5: Comparison of our postoperative testicular volume data for age groups on the affected side with the average testicular volumes by age proposed by Matsuo, et al. [5].

Discussion

The prevalence of cryptorchidism at birth is 3.68% and 1.1% at three months, indicating a decrease in the prevalence and natural descent of the testes [6]. Furthermore, it has been reported that in patients who were preterm at birth, the testes spontaneously descended by the age of six months in all patients [7]. Therefore, undescended testicles may descend spontaneously within six months after birth.

Cryptorchidism means imperfect (or incomplete) descent of the testis. The testis fails to reach the scrotum. It can be found in the abdomen (lumbar area or iliac fossa), inguinal canal or superficial inguinal ring. While in a mal-descended case, the testis descends to an abnormal location, outside the normal landing path. The reason may be the division of the gubernaculum. It can be found in the front of the abdominal wall, the front of the thigh or perineum, behind the scrotum [8]. It has been reported that when the testis is outside the scrotum, numerous literature reports regarding the risk of cryptorchidism. Histological abnormalities of the tests have been reported to be associated with reduced fertility, malignancy [9] and an increased risk of testicular torsion [10].

Regarding the timing of surgery for cryptorchidism and fertility, early surgery is recommended to prevent histological changes or damage to the testicles with age. In 1929, Cooper reported that at 1.5 years, atrophy of seminiferous tubules, a decrease in spermatogonial cells and hyperplasia of the interstitium were observed [11]. In addition, it has been reported that the rate of paternity acquisition decreases by 50% after 3 years [12].

Based on these reports, the Japanese Pediatric Urological Society recommends surgical timing of approximately one to two years of age. Our results showed an increase in the testicular volume of secondary sexual characteristics in the group in which surgery was performed between the ages of 1 and 3 years and the preoperative-to-postoperative testicular volume ratio on the affected side was significantly higher. This finding was similar to the timing recommended by the guidelines.

Matsuo, et al., compared the average testicular volume of 692 Japanese boys measured using a Prader orchidometer during childhood with that of Swiss boys [5]. According to their report, the onset of puberty (defined as testicle growth to a volume of 3-4 mL) occurred at the average age of 10.8-11.5 years old in Japan. In addition, it was shown that the average testicular volume was 10 mL at > 10 years of age. In contrast, the postoperative testicular volume in our study was lower than the average testicular volume by age, as reported by Matsuo, et al. (Fig. 5). Furthermore, the average testicular volume on the healthy side was larger than that on the affected side (8.38 mL vs 6.56 mL) but it was smaller than that reported by Matsuo, et al. The testicular volume in the group that underwent surgery before the age of 3 years was larger than in all operated patients, but smaller compared to the average value determined by Matsuo, et al. It is unclear whether this result is due to the timing of the surgery or the effect of cryptorchidism as a congenital disorder. However, this analysis was based only on ultrasound evaluation. Additional surgical findings, blood tests for hormones (luteinizing hormone, follicle-stimulating hormone and testosterone) and factors influencing other secondary sexual characteristics should be considered.

Sakamoto, et al., investigated testicular size and function by calculating testicular volume using ultrasound sonography in 408 infertile men and reported that if the testicular volume was less than 10 mL, the sperm count was lower than normal and there was a correlation with testicular function [13,14]. Okuno, et al., examined the long-term prognosis of 43 patients after surgery for cryptorchidism. Semen analysis showed normal counts in 16 patients (61.5%), oligospermia in eight patients (30.8%) and azoospermia in one patient (3.8%). In addition, in patients with unilateral cryptorchidism, they found that testicular volume on the healthy side tended to be more related to sperm concentration than on the affected side. Furthermore, testicular function on the healthy side was primarily involved in semen findings [15]. Compared to the above report, our data showed that the average postoperative testicular volume was 6.56 mL at ages over 10 years and that of the healthy side was 8.38 mL, which is lower than the average value (10 mL) proposed by Sakamoto, et al., and Okuno, et al. [13-15].

The postoperative evaluation of function and fertility in cryptorchidism during adolescence remains controversial and partner and social factors also influence future outcomes. The limitations of this study include a small sample size and a lack of ethnic diversity.

Conclusion

After surgery for cryptorchidism, we followed up with the patients until the onset of secondary sexual symptoms and obtained testicular volume data. The results showed that the optimal timing of surgery was between 1 and 3 years, which is consistent with the recommendations of the guidelines. The volume of patients after orchiopexy was lower than that in the nonsurgical group. Our data indicate the need for extended follow-up in adolescence and young adulthood. Large-scale multicenter studies including patients of various ethnicities should be conducted in the future.

Conflict of Interest

The authors declare no conflicts of interest.

Funding Statement

The authors did not receive support from any organization for the submitted work.

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Data Availability Statement

Data on the research subjects will be stored while ensuring that their personal information is strictly anonymized.

Ethical Statement

The ethics committee of our hospital approved the clinical research (ethics review number: B0443). The study was performed in accordance with the ethical standards of the 1964 Declaration of Helsinki and its later amendments.

Informed Consent Statement

All patients consented to the surgery and retention of testicular data. Our clinical research was a retrospective review of medical records and did not involve direct interaction with patients. Therefore, this study was conducted by posting a prior notice in the hospital and obtaining consent from the ethics committee.

Authors' Contributions

M.O., R.I. and Y.F. performed the surgery. All authors have read and approved the final version of the manuscript.

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