


ORIGINAL RESEARCH

Open Access



Management of cryptorchidism in adolescent and adult males

J. T. Viljoen¹, A. Zarrabi² and A. Van der Merwe^{2*} 

Abstract

Background: In developing countries, it is not unusual for patients with undescended testes (UDT) to present in adulthood and the late detection of UDT can be problematic. The limited contribution to fertility and increased potential of malignancy seen in UDT have swayed many authors towards recommending orchidectomy, rather than orchidopexy, for the adult patient presenting with cryptorchidism. With conflicting data, and most guidelines aimed at first world countries with pre-pubertal patients as their focus group, a lot of uncertainty exists regarding the management of adults who present with cryptorchidism. This may result in variation in the approach to management of this patient population.

Methods: A retrospective review was conducted of patients with cryptorchidism, aged 12 years or older at the time of surgery. The following data were retrieved: patient's age, medical and previous surgical history, clinical features of UDT (laterality, position and size), date of surgery, intra-operative findings and procedure performed. Management decisions were compared to the most recent guidelines.

Results: The mean age of the 106 subjects was 25.4 years. An orchidectomy was performed in a total of 30 (24.2%) of the 124 testicular units. The majority of testes, 91 (73.4%), in this group were preserved. Of these, 43 (47.3%) were older than 18 years of age, 33 (36.2%) were reported as having unilateral UDT with a normal contralateral testis and in 9 (9.8%) of these cases, the preserved testes were described as being atrophic. The majority (59.7%) of UDT in the post-pubertal group (> 18 years) were managed by orchidopexy.

Conclusion: Contrary to the recommended treatment for this group of patients, there was a general tendency towards testicular preservation. The decision on surgical management was made by the attending surgical team. This not only demonstrates variation in the management of UDT, but could also be a reflection of the lack of sufficient guidelines as to the management of the post-pubertal patient presenting with UDT. Further studies, following cryptorchidism through adulthood, are needed to refine guidelines for the optimal management of this group of patients.

Keywords: Undescended testis, Cryptorchidism, Orchidopexy, Orchidectomy, Adult, Adolescent

1 Background

Many aspects of cryptorchidism remain controversial; this includes the management of the adolescent or adult male with an undescended testis (UDT). In developed countries, cryptorchidism is usually diagnosed in early childhood and the gold standard in management is early

anatomical correction by orchidopexy [1–11]. However, in developing countries, it is not unusual for these patients to present in adulthood and the late detection of UDT can be problematic [3, 12, 13]. The malignant potential [2, 7, 8, 12, 14–21] and the loss of function of the cryptorchid testis are well established, with several studies confirming the deterioration of spermatogenesis and loss of endocrine function [1–8, 10, 11, 14, 16, 18–20, 22]. The limited contribution to fertility and increased potential of malignancy seen in UDT have swayed many authors towards recommending orchidectomy, rather

*Correspondence: arvdm@sun.ac.za

² Department of Urology, Faculty of Health Sciences, Stellenbosch University, P.O. Box 19063, Tygerberg 7505, South Africa
Full list of author information is available at the end of the article

than orchidopexy, for the adult patient presenting with cryptorchidism [3, 10, 15, 17, 23]. However, later studies have proved the malignant potential to be much lower than initially thought [7, 14, 15, 17, 19] and several studies have shown residual testicular function in a number of the cryptorchid testes, even after late surgical correction [15, 20, 24, 25]. With conflicting evidence and the most widely used guidelines originating in the first world countries with pre-pubertal patients as their focus group, a lot of uncertainty remains regarding the management of adults who present with cryptorchidism. Although broadly standardised, the guidelines for the management of these patients seem insufficient [14]. This may result in the detailed guidelines, mostly intended for the pre-pubertal patient, be extrapolated to post-pubertal patients as well.

The aim of this study was to review the clinical presentation and management of cryptorchidism in patients who presented during adolescence or adulthood at Tygerberg Hospital (TBH), a tertiary institution in Cape Town, South Africa.

2 Methods

A retrospective review was conducted of patients with cryptorchidism aged 12 years or older, at the time of surgery. Patients were identified by using the computerised database of surgical procedures and ward admissions in the Department of Urology.

The clinical records were reviewed, and the following data were retrieved: patient's age, medical and previous surgical history, clinical features of UDT (laterality, position and size), date of surgery, intra-operative findings and procedure performed. Hormonal assays, spermograms and histopathological evaluation of the excised specimen were not part of investigative protocols; therefore, results were incomplete and were not considered relevant to the objective of this study. Statistical analysis was performed using Student's *t* test or Mann–Whitney

test for continuous data with normal or non-normal distribution, respectively, and Fisher's exact test for contingency table analysis ($p < 0.05$ accepted as statistically significant). Management decisions were compared to the most recent guidelines.

3 Results

A total of 504 patients with UDT underwent surgery at TBH during the period January 1999 to December 2011. Based on the age inclusion criteria, 106 subjects (21%) of 12 years or older were included in the study, 47 were between 12 and 18 years of age, and 59 were older than 18 years. The mean age at the time of surgery was 25.4 years, with the oldest subject being 41.4 years old. Unilateral right UDT was present in 50 of 106 subjects (47.2%), unilateral left UDT in 38 (35.8%) and bilateral UDT in 18 subjects (17%), totalling 124 testicular units. Pre-operative clinical and intra-operative findings are shown in Table 1.

An orchidectomy was performed in a total of 30 (24.2%) of the 124 units; one of these was located in the scrotum, 16 (53%) of these were reported to be in the region of the inguinal canal and three (10%) were located intra-abdominally. In ten cases (33.3%), the position of the UDT was not recorded. Of the 30 testes treated by orchidectomy, 14 (46.7%) were described as atrophic, one testis was described as normal, and in the other cases, the size was not stated. For the case in which an orchidectomy was performed for a normal looking testis, the indication was inadequate length of the spermatic cord for an orchidopexy. One patient underwent bilateral orchidectomy for atrophic testes.

A comparison of the clinical findings and management between the groups with non-palpable and palpable testes is shown in Table 2. In the group with the non-palpable testes, UDT was found to be significantly more often bilaterally and intra-abdominally. Of this group, 24 (63.8%) were managed by orchidopexy of whom ten

Table 1 Clinical and intra-operative findings

Clinical examination	<i>n</i> = 124 (%)	Intra-operative findings	<i>n</i> = 124 (%)
Position		Position	
Non-palpable	37 (27.4)	Abdominal	14 (11.3)
		Absent	3 (2.4)
Inguinal canal	42 (33.9)	Inguinal canal	30 (24.2)
External ring	9 (7.2)	External ring	11 (8.9)
Internal ring	6 (4.8)	Internal ring	16 (12.9)
Inguinal pouch	3 (2.1)	Inguinal pouch	16 (12.9)
Scrotal	6 (4.8)	Scrotal	2 (1.6)
Unknown/not recorded	21 (16.9)	Unknown/not recorded	33 (26.6)

Table 2 Comparison between non-palpable and palpable undescended testes, clinical findings and management

Number	Non-palpable UDT n = 37 (%)	Palpable UDT n = 66 (%)	p value
Mean age (years)	21.7	20.5	
Unilateral	20 (54.1)	54 (81.8)	
Bilateral	17 (45.9)	12 (18.2)	0.024
Intra-abdominal UDT	11 (29.7)	2 (3)	0.001
Inguinal region (inguinal canal, internal and external inguinal rings)	14 (37.8)	43 (65.2)	
Absent testis	3 (8.1)	0/66	
Orchidopexy	15 (40.5)	48 (72.2)	
Orchidectomy	13 (35.1)	17 (25.7)	0.321
Fowler–Stephens procedure	9 (24.3)	1 (1.5)	<0.001

Table 3 Comparison between adolescent and post-pubertal patients, clinical findings and management

	12–18 years old	> 18 years old	p value
Number of patients	n = 47 (%)	n = 59 (%)	
Unilateral UDT	42 (89.4)	46 (78%)	
Bilateral UDT	5 (10.6)	13 (22%)	0.309
Testicular units	n = 52 (%)	n = 72 (%)	
Intra-abdominal UDT	8 (15.4)	6 (8.3)	0.179
Absent testis	1 (1.9)	2 (2.7)	
Orchidopexy	42 (80.8)	39 (54.2)	
Orchidectomy	3 (5.8)	27 (37.5)	<0.001
Fowler–Stephens procedure	6 (11.5)	4 (5.5)	0.127

(41.6%) were reported to have had unilateral UDT with a normal contralateral testis. In one case, the preserved testicle was described as being atrophic.

In the group with the palpable UDT, 17 cases were managed by orchidectomy; of these cases, eight were described as being atrophic, one was described as normal, and in eight cases, there was no mention of the characteristics of the affected testes. The one patient in this group who underwent orchidectomy for a clinically normal cryptorchid testis was 39.8 years of age. In the group with the palpable UDT, 49 (74.2%) of the 66 cases were managed by orchidopexy, 23 (46.9%) of these patients were reported to have had normal contralateral testes and in six (12.2%) of these cases, the preserved testes were described as being atrophic.

A different perspective is to look at the clinical findings and management of different age groups within the same patient population. For this, a comparison was made between the adolescent (12–18 years) and post-pubertal patient groups (> 18 years); results are shown in Table 3.

Unilateral and intra-abdominal testes were more common in the younger age group, but differences were

not statistically significant. Orchidectomy was performed more often in the older age group ($p < 0.001$). The average age of the patients that were managed by orchidectomy was 25.5 years, compared to the average of 19.2 years for those managed by orchidopexy.

Orchidopexy was performed more often in the pubertal group than the post-pubertal group, 80.8% and 54.2%, respectively. The majority of the testes (92.3%) in the pubertal group were managed by preservative measures; two of these (4.5%) were described as atrophic with a normal contralateral testis. Of the 48 units that were preserved in the adolescent group, 20 (41.6%) were reported to be unilateral UDT with normal contralateral testes. In the post-pubertal group, a similar trend was demonstrated with the majority of UDT, 43 (59.7%) preserved. Of these 43 testes, five (11.6%) of the affected testes were described as atrophic and 13 (30.2%) were reported to have unilateral UDT with a normal contralateral testis. Four patients in the post-pubertal group were managed by Fowler–Stephens orchidopexy; three of these were for bilateral UDT and one patient had unilateral UDT with normal contralateral testis. In the adolescent group, six patients were managed by Fowler–Stephens orchidopexy of whom one had bilateral UDT.

Of the 124 units, a total of 23 (18.5%) were described as either atrophic or hypotrophic. Fourteen (60.9%) of the 23 atrophic units were managed by orchidectomy and nine (39.1%) by means of orchidopexy. Six of these atrophic testes (26%) were found in the post-pubertal group, and all of them were managed by orchidopexy. Of the total of 91 testes that were preserved, 43 (47.3%) were older than 18 years of age and 33 (36.2%) were reported as having unilateral UDT with a normal contralateral testis. In nine (9.8%) of these cases, the preserved testes were described as being atrophic.

4 Discussion

Cryptorchidism is the most common malformation of male sexual development, with an overall prevalence rate of 3% in full-term newborn males. Most palpable UDT spontaneously descends within the first months of life, decreasing the prevalence to 1–2% for boys aged 6 months to one year [1, 2, 7, 14, 17]. The right side is affected more often than the left, occurring in 70% of cases. The majority of cases present with a palpable UDT, non-palpable testes accounting for approximately 20% of all cases [2]. This tendency was similarly reflected in the patient population of this study with right UDT occurring in 62% of cases, and no palpable testes were found in 29.8% of cases.

The undescended testis is a risk factor for both infertility and testicular malignancy. The histopathological and functional changes of the cryptorchid testis are well established with defective spermatogenesis and the loss of endocrine function being early consequences [2, 4, 5, 7, 8, 14–16, 18, 19, 26]. The histopathological hallmarks with degeneration of Sertoli cells, decreased numbers and defective maturation of germ cells, as well as hypoplasia of the Leydig cells, are evident from as early as one year of age [2, 4, 6, 15, 20]. Bilateral UDT is more significantly correlated with infertility, with azoo- or oligospermia reported in 66–87.5% of cases, compared to 33–35% of cases with unilateral UDT [4, 6, 11, 14, 15, 26]. Normal fertility rates are reported in 87–90% of patients undergoing repair within the first 2 years of life [4, 6, 8, 14–16, 26]. This figure is similar to fertility levels found in the general population [8]. Abnormal spermatogenesis is reported to be as high as 98% in the cryptorchid testis of post-pubertal men [10]. Fertility assessment was not part of routine investigative protocol in this cohort; however, the relevance is noted by the above percentages and should be included in future studies in refining management guidelines.

Besides the malignant potential and the loss of function of the cryptorchid testis influencing the approach to the management of UDT, other factors that have been recorded as fundamental are: the apparent increased risk of the UDT for undergoing torsion, the abnormal position predisposing it to trauma and the psychological benefit of having intrascrotal testes [14]. Early surgical correction is still the gold standard of the management of UDT [1, 3, 5–8, 14–19, 23]. Guidelines for the pre-pubertal patients are well defined; however, those applicable to the post-pubertal patient seem far more rudimentary and have remained unchanged for a number of years. The current AUA guidelines [8] with reference to the post-pubertal patients are as follows:

- In the post-pubertal child with cryptorchidism, consideration should be given to performing an orchiectomy or biopsy.
- In boys with a normal contralateral testis, surgical specialists may perform an orchidectomy (removal of the undescended testis) if a boy has a normal contralateral testis and either very short testicular vessels and vas deferens, dysmorphic or very hypoplastic testis, or post-pubertal age.

The EAU guidelines [27] similarly state:

- For the UDT in the post-pubertal patient who has a normal contralateral testis, discuss orchidectomy because of the theoretical risk of later malignancy.

Little has been reported on patients presenting with UDT during adolescence or adulthood, particularly in developing countries [3, 7, 13]. The apparent loss of function and malignant potential of the UDT have swayed many authors towards doing orchidectomy for the adult patient, rather than orchidopexy [14, 15, 17, 23]. As mentioned previously, although standardised, uncertainty exists regarding the management of these patients and the current guidelines seem insufficient [14]. Several attempts have been made to refine these recommendations. Halachmi et al. [10] concluded that adult patients with unilateral UDT and a normal contralateral testis should be offered an orchidectomy. Patients with a single testis or bilateral UDT may be considered for testis-preserving management with regular follow-up. When comparing peri-operative mortality for UDT with mortality due to testicular germ cell neoplasia in post-pubertal patients, Farrer et al. recommended limiting surgical intervention to patients aged 32 years or younger [3]. With improvement of peri-operative care, OH et al. [23] demonstrated that in the American Society of Anaesthetists (ASA) class I and II groups, mortality from orchidectomy only began to exceed mortality from germ cell tumours at the age of 50 years. In accordance with these findings, the following recommendations were made:

- For post-pubertal adolescents and healthy men younger than 50 years of age (ASA I/II) with unilateral UDT and normal contralateral testis, an orchidectomy should be offered.
- Men older than 50 years of age or those with high anaesthetic risk (ASA III/IV) should be considered for close observation.
- Men with bilateral UDT should undergo testicular biopsies, preservative management and close observation.

Earlier publications have reported the malignant risk to be 40 times higher than that of the general population [2]; however, more recent studies have estimated this to be much lower with a relative risk of 2.75–8 [7, 14, 15, 17, 19]. That, along with the improved oncological outcome of testicular germ cell neoplasia, may have caused a perceptual shift in clinicians and patients alike. There seems to be more consideration for testicular preservation, in spite of the malignant risk and the slim chance of improved fertility [28]. In the clinical setting, it is also difficult to determine the residual function of the cryptorchid testis. In two studies of post-pubertal men managed for UDT, Rogers and Koni et al. demonstrated germ cells at different levels of maturation in 31% and 51% of patients, respectively [15, 20]. Similarly, two separate studies by Shin et al. [24] and Lin et al. [25] reported cases which demonstrated commencement of spermatogenesis resulting in pregnancy, after late surgical correction of UDT. In a review article, Chung et al. [29] made a case for testicular preservation in patients who still desire parenthood, but also the elderly, where there is no further risk of malignancy. In his conclusion, he proposed guidelines for this specific group of patients which is similar to what OH et al. proposed, with the added recommendation: in post-pubertal patients with a non-palpable UDT, laparoscopic orchidectomy is preferred. All of this makes for a strong argument that in some instances there may be rationale for testicular preservation and that the decision to treat a post-pubertal patient with cryptorchidism must be made on an individual basis, rather than adhering to stringent recommendations.

In the pubertal group, 48 of UDT (92.3%) were treated by means of orchidopexy. In this group, two testes (4.5%) were described as atrophic with a normal contralateral testis; contrary to recommendations, these two testes were preserved. Three testes (5.7%) in the pubertal group were managed by orchidectomy. One of these was described as atrophic, and in another, there was inadequate length of the spermatic cord for orchidopexy. The reason for the orchidectomy in the third case was not stated.

Of the 124 units, 23 (18.5%) were described as being either atrophic or hypotrophic, with a normal contralateral testis. In accordance with AUA guidelines, the majority (60.9%) of these were managed by orchidectomy; however, nine (39.1%) units were preserved.

Eighteen patients had bilateral UDT, totalling 36 units. The majority of bilateral UDT (88.8%) were managed by orchidopexy in accordance with recommendations; however, three patients had undergone orchidectomy of whom one was for bilateral atrophic testes.

Based on the mean age of 25.4 years, with the oldest patient being 41.4 years of age, orchidectomy would

have been indicated in the majority of patients, yet in only 30 units (24.2%) this was seen as the management of choice. Comparing the pubertal- and post-pubertal groups, orchidectomy was more often performed in the post-pubertal group, still the majority of UDT in this group (59.7%) were managed by preservative measures. Of these 43 testes, five (11.5%) were described as atrophic and 13 (30.3%) of cases were unilateral with a normal contralateral testis, all indications for orchidectomy rather than orchidopexy. A total of 14 surgeons were involved in the cases where orchidopexy was performed for the post-pubertal patient with an atrophic UDT, or UDT with normal contralateral testis. All of these surgeries were performed by trainees, while working under the close supervision of consultant Urologists and the decision to do orchidopexy, rather than orchidectomy, was not stated. Twenty-seven of UDT (37.5%) in the post-pubertal group were managed by orchidectomy; in 13 (48.1%) of these, the affected testes were described as atrophic and seven (25.9%) were not palpable with clinical examination. We concluded that in this setting there was a general tendency towards testicular preservation in this age group, despite guidelines recommending otherwise. Certain factors which seemed to sway the decision-making towards orchidectomy have been identified: age of the patient, an intra-operative finding of an obvious atrophic testis and if an orchidopexy was deemed practically impossible.

Certain limitations of this study have been identified; it was a single-centre study which may have biased the results and may not be generalisable to other institutions. It is a retrospective review, with some data lacking due to incomplete record keeping and different investigative protocols. On an individual, case-by-case basis, the reason of the preferred management option was not stated. Therefore, results are based on deductions from data analysis, rather than surgeons' individual and clinical decision-making. Many patients were lost to follow-up, and there were limited data on these follow-up findings.

5 Conclusion

This study showed a general tendency towards testicular preservation with the majority of patients undergoing orchidopexy, in spite of guidelines recommending otherwise.

The decision to do orchidopexy, rather than orchidectomy, was made by the surgical team. This not only demonstrates individual variation in the approach to the management of UDT, but could also be a reflection of lack of sufficient guidelines as to the management of the post-pubertal or adult patients presenting with UDT.

With advances in medical care and improvement of patient compliance, there may be a case to be made for

managing selected adult patients presenting with UDT, by means of orchidopexy rather than orchidectomy. Further studies following cryptorchidism through adulthood may provide new insight and guidance as to the optimal management of this group of patients.

Abbreviations

ASA: American Society of Anaesthetists; AUA: American Urological Association; OR: overall risk; ROC: reactive oxygen species; TBH: Tygerberg Hospital; UDT: undescended testes.

Acknowledgements

Prof CF Heyns contributed greatly to the writing up of the manuscript but passed away before the manuscript could be submitted for publication.

Authors' contributions

JTV was responsible for the data collection and writing up of the manuscript; AZ assisted with the writing up of the manuscript; AvdM assisted with the writing up of the manuscript. All authors have read and approved the manuscript.

Funding

No external funding was received for the research; departmental funds were used.

Availability of data and material

The datasets used and analysed during the current study are available from the corresponding author on reasonable request.

Ethics approval and consent to participate

The Human Research Ethics Committee reviewed the protocol, including the methodology and statistical methods to be employed, and approval was obtained under the number S12/04/089. This was a retrospective review and consent was waived.

Consent for publication

Not applicable.

Competing interests

There is no conflict of interest to declare by all authors. No competing financial interests exist.

Author details

¹ Military Hospital, Hospital Road, Wynberg 7800, South Africa. ² Department of Urology, Faculty of Health Sciences, Stellenbosch University, P.O. Box 19063, Tygerberg 7505, South Africa.

Received: 6 November 2019 Accepted: 14 July 2020

Published online: 22 September 2020

References

- Bradshaw CJ, Corbet-Burcher G, Hitchcock R (2014) Age at orchidopexy in the UK: has new evidence changed practice? *J Pediatr Urol*. Pubmed search www.ncbi.nlm.nih.gov/pubmed/24517905. Online 22 January 2014
- Comploj E, Pycha A (2012) Diagnosis and management of cryptorchidism. *Eur Urol Suppl* 11(2):2
- Kucheria R, Sahai A, Sami TA (2005) Laparoscopic management of cryptorchidism in adults. *Eur Urol* 48(3):453
- Kurpisz A, Havryluk A, Nakonechnyi A (2010) Cryptorchidism and long-term consequences. *Reprod Biol* 10(1):19
- Hutson JM (2013) Undescended testis: the underlying mechanisms and the effects on germ cells that cause infertility and cancer. *J Pediatr Surg* 48(5):903
- Taskinen S, Hovatta O, Wikstrom S (1996) Early treatment of cryptorchidism, semen quality and testicular endocrinology. *J Urol* 156(1):82
- Thorup H, McLachlan R, Cortes D (2010) What is new in cryptorchidism and hypospadias—a critical review on the testicular dysgenesis hypothesis. *J Pediatr Surg* 45(10):2074
- Kolon TF, Hemdon CD, Baker LA (2014) Evaluation and treatment of cryptorchidism: AUA guidelines. *J Urol* 192(2):337
- Hutson JM, Hasthorpe S (2005) Testicular descent and cryptorchidism: the state of the art in 2004. *J Pediatr Surg* 40(2):297
- Halachmi S, Pillar G (2008) Congenital urological anomalies diagnosed in adulthood and management considerations. *J Pediatr Surg* 43(1):2
- Mathers MJ, Sperling H, Rubben H (2009) The undescended testis: diagnosis, treatment and long-term consequences. *Dtsch Arztebl Int* 106(33):527
- Ritze EM (2008) Undescended testes: a consensus on management. *Eur J Endocrinol* 159(1):87
- Sinha CK, Vinay S, Kulkarni R (2008) Delayed diagnosis for undescended testes. *J Ind Pediatr* 45(6):503
- Hutson JM, Clarke MC (2007) Current management of the undescended testicle. *Sem Pediatr Surg* 16(1):64
- Rogers E, Teahan S, Gallagher H (1998) The role of orchietomy in the management of postpubertal cryptorchidism. *J Urol* 159(3):851
- Van Der Plas EM, Zijp GW, Froeling F (2013) Long-term testicular volume after orchiopey at diagnosis of acquired undescended testis. *J Urol* 190(1):257
- Wood HM, Jack S (2009) Cryptorchidism and testicular cancer: separating fact from fiction. *J Urol* 181(2):452
- Chen Y, Huang W, Huang K (2013) Factors related to the time to cryptorchidism surgery: a nationwide, population-based study in Taiwan. *J Formosan Med Assoc*. Pubmed Search www.ncbi.nlm.nih.gov/pubmed/23883792. Online 21 July 2013
- Walsh TJ, Dall'Era MA, Croughan MS (2007) Prepubertal orchiopey for cryptorchidism may be associated with lower risk of testicular cancer. *J Urol* 178(4):1440
- Koni A, Ozseker HS, Arpali E (2014) Histopathological evaluation of orchidectomy specimens in 51 late postpubertal men with unilateral cryptorchidism. *J Urol*. Pubmed Search www.ncbi.nlm.nih.gov/pubmed/24840535. Online 17 May 2014
- Carson JS, Cusick R, Mercer A (2014) Undescended testes: does age at orchiopey affect survival of the testis? *J Pediatr Surg* 49(5):770
- Kraft KH, Canning DA, Snyder HM (2012) Undescended testis histology correlation with adult hormone levels and semen analysis. *J Urol* 188(4):1429
- Oh J, Landman J, Evers A (2002) Management of the postpubertal patient with cryptorchidism. *J Urol* 167(3):1329
- Shin D, Lemack GE, Goldstein M (1997) Induction of spermatogenesis and pregnancy after adult orchiopey. *J Urol* 158(6):2242
- Lin YM, Hsu CC, Wu MH (2001) Successful testicular sperm extraction and paternity in an azoospermic man after bilateral postpubertal orchiopey. *Urology* 57(2):365
- Hutson JM, Balic A, Nation T (2010) Cryptorchidism. *Sem Pediatr Surg* 19(3):215
- Radmeyer C, Dogan HS, Hoebcke P (2016) Management of undescended testes: European association of urology. *J Pediatric Urol* 12(6):335
- Jeong SC, Seungsoo L, Ku JY (2014) Clinical characteristics and treatment of cryptorchidism in adults: a single centre experience. *World J Mens Health* 32(2):110
- Chung JM, Lee SD (2015) Individualised treatment guidelines for postpubertal cryptorchidism. *World J Mens Health* 33(3):161

Publisher's Note

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.