Coc Cer Derg/Turkish J Ped Surg 2022;36(3): 19-27
doi:10.29228/JTAPS.62854

Research Article

Çocuk Cerrahisi Dergisi
Turkish Journal of Pediatric Surgery
Volum 36
Number 3
2022

A Prospective Study: Can physical examination identify palpable undescended testes more accurately than ultrasonography?

Mustafa Akman

Medipol University, Faculty of Medicine, Bahçelievler Hospital, Department of Pediatric Surgery, İstanbul-TÜRKİYE

ABSTRACT

Introduction: The cremasteric reflex, which makes the testicle mobile, and excessive scrotal adipose tissue may mimic scrotal emptiness, leading to the evaluation of cases as undescended testes. Although it has been suggested that the location of the testes cannot be determined by imaging tests, suspicious localization may lead the physician to imaging tests. This study reveals the needlessness of ultrasonography (USG), especially in palpable cases.

Methods: In our study, patients who had their initial evaluation and USG performed by a pediatrician were targeted. Finally, a pediatric surgical evaluation was performed by a single pediatric surgeon, and the findings were compared. The cases were divided into two groups, normal and abnormal testicles, based on the pediatrician's distinction. According to this distinction, all cases were evaluated as a whole. Testes that could not maintain their position within the scrotum were considered abnormal. Consistency was sought in intergroup relations with Cohen's Kappa.

Results: The study was conducted with 75 patients who met the criteria. In the group with normal localization in the pediatrician examination, pediatric surgical evaluation was compatible in one (2.6%) of the cases reported as abnormal on USG and 38 (100%) of the cases reported as normal on USG. In the group with abnormal localization in the pediatricians' examination, pediatric surgical evaluation was compatible with 32 (40%) of the cases reported as abnormal on USG and four (100%) of the cases reported as normal on USG.

Discussion: Radiologic examination of testicles, the localization of which cannot be ascertained by USG, began in the 1970s and is still being practiced. Some institutional bodies and independent researchers express opposing views, and some authors suggest that USG should be used.

Conclusion: The popularity of USG does not seem to be ending. In our study, the findings showed that the number of patients referred to surgery by USG was significantly higher. The findings obtained in this study suggest that imaging should be confined to non-palpable cases and USG only, and diagnostic laparotomy should be accepted as the gold standard. Relying on normal pediatric exams and being skeptical of abnormal reports revealed by USG will mean staying on the safe side.

Keywords: *Undescended testis, Ultrasonography, Physical examination*

Received / Geliş: 08.06..2022
Accepted / Kabul: 20.12.2022
Published Date: 15.12.2022

Cite as: Akman M. A Prospective Study: Can physical examination identify palpable undescended testes more accurately than ultrasonography? Coc Cer Derg/Turkish J Ped Surg 2022;36(3): 19-27. doi:10.29228/JTAPS.62854

Mustafa Akman

Medipol University, Faculty of Medicine, Bahçelievler Hospital,

Department of Pediatric Surgery, İstanbul-TÜRKİYE

drmustafaakman@yahoo.co.uk

ORCID: 0000-0002-6789-4585

Introduction

Cryptorchidism was first described in the medical literature in 1786 by Hunter. The first surgical orchiopexy was performed in 1877 by Annandale. The term cryptorchidism, which is derived from the Greek words kryptos (hidden) and orchis (testicle), signify the most common genital anomaly in male infants, with a high prevalence of 3%. The testes are in an environment of 35°C provided by the scrotum and are not impacted by physical traumas that may occur due to their topographic localization. To protect the testes from harm, the cremasteric reflex moves it in response to heat and cold. The testicle, which changes its location with reflex stimulation, may lead to the scrotum appearing empty. This reflex is rapid and distinct in some individuals diagnosed with retractile testes. In addition, subcutaneous adipose tissue being different and more than usual may cause the scrotum to be considered empty and may mimic the testes being in the inguinal canal and the scrotum being empty. Because of these three main reasons, testicles that are normally in place but cannot be detected during examination cause confusion [1-5].

Retrograde venography, MR, and CT can be used to confirm the anatomical position. All three methods require the administration of sedation or anesthesia and CT exposures of radiation, and they are more or less invasive. It seems that USG will remain indispensable, as it does not emit ionizing rays, is non-invasive, and does not require sedation and anesthesia. Low cost, prevalence, and easy access play a key role in the widespread use of USG. Parental pressure and the need for anxiety relief may act as a driving force in the primary physician's preference for USG. Paradoxically, low sensitivity may increase parental anxiety (6-10). Our study aims to emphasize the issue by revealing the uselessness of USG imaging, notably in palpable cases [11].

Materiai and Methods

This study was commenced by reviewing Medline. Patients who were referred to the pediatric surgery outpatient clinic and had their initial evaluation and USG performed by a pediatrician were targeted. The first physical examination of the patients was conducted by the pediatrician; the second evaluation was made by the radiologist using USG; the final evaluation was made by the pediatric surgeon; and the results were compared. Each testes was evaluated independently. Cases of nonpalpable testes, in which the primary physician did not perform a USG examination, and cases with insufficient information about testicular localization were excluded from this study.

In this study, the ethical principles of the Declaration of Helsinki were strictly complied with, parents were informed, and their consent was obtained. Patient demographics, testicular localization, physician's remarks, and preoperative and postoperative results were noted. In this study, patient and physician identity data were kept confidential.

The pediatric surgical evaluation of the patients, whose clothes were removed to avoid stimulating the cremasteric reflex, was performed by a single pediatric surgeon at an appropriate room temperature and in the supine position. Examination of patients with severe crying jags or stress was delayed. Care was taken because the surgeon's hands were warm. In the primary examination, the patients were divided into two groups, normal and abnormal testicles, based on the distinction of the pediatrician. As with this distinction, all patients were evaluated as a whole regarding examination compatibility. In line with the flow diagram (Figure 1), they were divided into four subgroups to recognize the localization of the testes: intraabdominal, palpable suprascrotal, palpable upper portion of the scrotum, and palpable lower portion of the scrotum. Testes that were unable to maintain the palpable lower portion of the scrotum position were considered abnormal, while testes that could preserve it were considered normal. Retractile testicles were accepted as normal localization and included in the study.

Statistical Analysis

The Kappa statistic kappa value, which is designed for Cohen's kappa (κ) that is specifically designed for ordinal variables, is used to compare an observed accuracy with an expected accuracy (random chance). Cohen suggested the Kappa result be interpreted as follows: values ≤ 0 as indicating no agreement and 0.01–0.20 as none to slight, 0.21–0.40 as fair, 0.41– 0.60 as moderate, 0.61–0.80 as substantial, and 0.81–1.00 as almost perfect agreement. Consistency was sought in intergroup relations with Cohen's Kappa. For data processing, the April 2022 versions of Google Drive and Google Worksheet were used [12, 13].

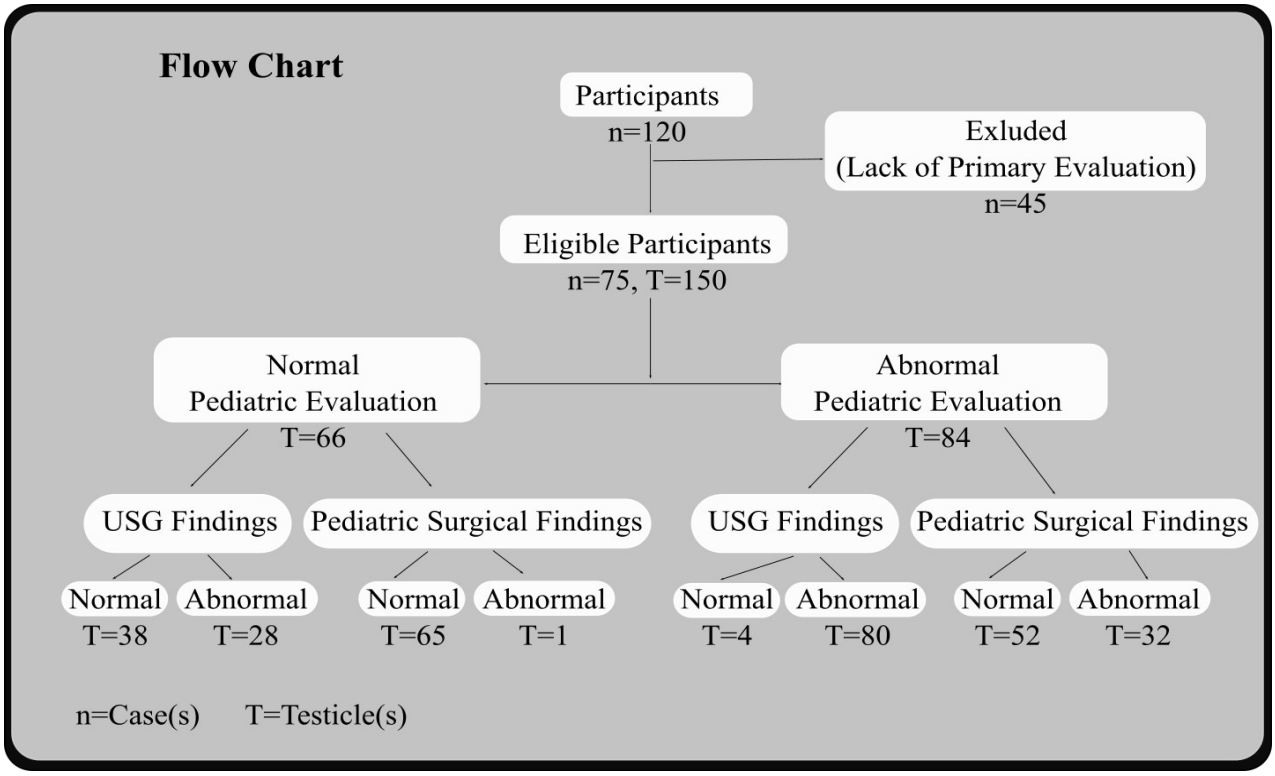

Figure 1. Flow chart.

Results

This study was conducted between May 2020 and December 2021. One hundred twenty patients with undescended testes were referred to our clinic. Of these, 45 patients were excluded from this study since they were evaluated inadequately by the pediatrician or USG was not ordered. The findings showed that 66 unilateral (132 testes) and nine bilateral (18 testes) suspicious localization patients were referred, 19 of which were on the left and 47 on the right belonged to the unilateral cases. This study was conducted with 150 testes and 75 patients, 84 of whom localization was suspected and 66 of whom were unsuspected. Each testes was evaluated independently. The median age was 10 months, the mean age was 10.08 months, and the most common age was 11 months in the patients whose age range was between six and 14 months.

Findings obtained in the examination of 66 testes, which were normally located in the pediatrician's examination: In the evaluation with USG, 28 testicles were abnormal, and 38 testicles were normally located. In the surgical evaluation, one testicle was abnormal, and 65 testes were normally located. The surgical evaluation was compatible with one (2.6%) of the cases reported with abnormal localization on USG and 38 (100%) of the cases reported with normal localization on USG. The surgical examination was compatible with the pediatric examination at a rate of 98.4%. As shown in Table I, Cohen's kappa comparing the results of USG and the surgeon's assessment was 0.04 (no agreement) (Figure 2).

Findings obtained in the examination of 84 testicles, which were abnormally located in the pediatrician's examination: In the evaluation with USG, it was determined that 80 testicles were abnormally localized and four testicles were normally localized. In the surgical evaluation, 32 testicles were abnormally localized, and 52 testicles were normally localized. The surgical evaluation was compatible with 32 (40%) cases reported with abnormal localization on USG and four (100%) cases reported with normal localization on USG. There was a 40% agreement between the surgical and pediatric examinations. Cohen's kappa comparing the results of USG and the surgeon's assessment was 0.06 (no agreement) (Table II) (Figure II).

Table 1. Cohen's Kappa comparing results (in normal pediatric evaluations).

		USG evaluation			
		Normal	Abnormal	n	%
Pediatric Surgical Evaluation	Normal	38	27	65	98,48
	Abnormal	0	1	1	1,52
		38	28	66	
		57,58%	42,42%		
		Pr(a)	PrI	**k**	
		0,59	0,57	0,04	

The Kappa result values ≤ 0 as indicating no agreement and 0.01–0.20 as none to slight, 0.21–0.40 as fair, 0.41– 0.60 as moderate, 0.61–0.80 as substantial, and 0.81–1.00 as almost perfect agreement.

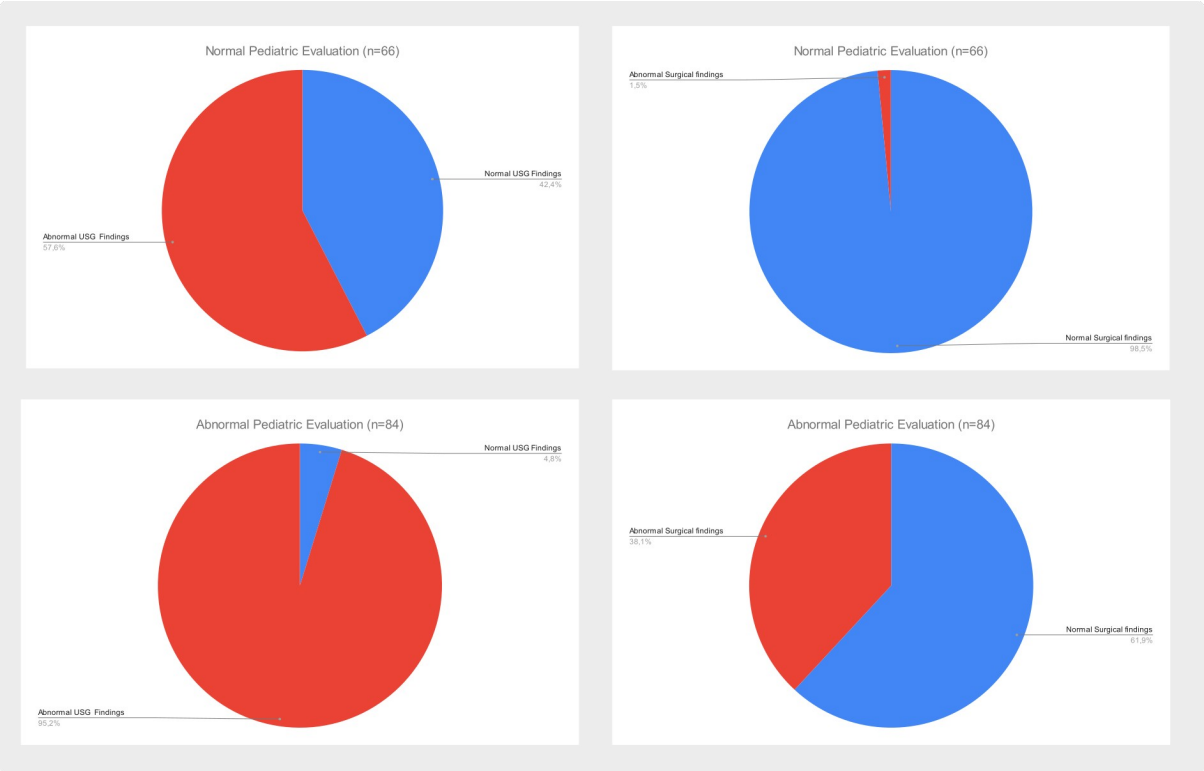

Figure 2. Comparative findings

When all cases were considered as a whole, the following Cohen's kappa comparison results, which were calculated according to all three independent evaluations, were obtained.

Cohen's kappa comparing the results of US and pediatric assessment was 0.55 (moderate agreement). Cohen's kappa comparing the results of pediatric and surgeon assessments was 0.34 (fair agreement). Cohen's kappa comparing the results of USG and the surgeon's assessment was 0.20 (slight agreement) (Table III, Table IV, Table V).

Table 2. Cohen's Kappa comparing results (in abnormal pediatric evaluations)

		USG Evaluation			
		Normal	Abnormal	n	%
Pediatric Surgical Evaluation	Normal	4	48	52	61,90
	Abnormal	0	32	32	38,10
		4	80	84	
		4,76%	95,24%		
		Pr(a)	Pr(e)	**k**	
		0,43	0,39	0,06 (Fair)	

The Kappa result values ≤ 0 as indicating no agreement and 0.01–0.20 as none to slight, 0.21–0.40 as fair, 0.41– 0.60 as moderate, 0.61–0.80 as substantial, and 0.81–1.00 as almost perfect agreement.

Table 3. Comparing USG and Pediatric evaluation

		USG Evaluation			
		Normal	Abnormal	n	%
Pediatric Evaluation	Normal	38	28	66	44,00
	Abnormal	4	80	84	56,00
		42	108	150	
		28,00%	72,00%		
		Pr(a)	Pr(e)	**k**	
		0,79	0,53	0,55 (Mod)	

The Kappa result values ≤ 0 as indicating no agreement and 0.01–0.20 as none to slight, 0.21–0.40 as fair, 0.41– 0.60 as moderate, 0.61–0.80 as substantial, and 0.81–1.00 as almost perfect agreement.

Table 4. Comparing USG and Pediatric surgical evaluation

		USG evaluation			
		Normal	Abnormal	n	%
Pediatric Surgical Evaluation	Normal	42	75	117	0,78
	Abnormal	0	33	33	0,22
		42	108	150	
		0,28	0,72		
		Pr(a)	Pr(e)	k	
		0,5	0,38	0,2 (Slight)	

The Kappa result values ≤ 0 as indicating no agreement and 0.01–0.20 as none to slight, 0.21–0.40 as fair, 0.41– 0.60 as moderate, 0.61–0.80 as substantial, and 0.81–1.00 as almost perfect agreement.

Table 5. Comparing Pediatric and Pediatric evaluation

		Pediatric Evaluation			
		Normal	Abnormal	n	%
Pediatric Surgical Evaluation	Normal	65	52	117	78,00
	Abnormal	1	32	33	22,00
		66	84	150	
		44,00%	56,00%		
		Pr(a)	Pr(e)	**k**	
		0,65	0,47	**0,34** (Fair)	

The Kappa result values ≤ 0 as indicating no agreement and 0.01–0.20 as none to slight, 0.21–0.40 as fair, 0.41– 0.60 as moderate, 0.61–0.80 as substantial, and 0.81–1.00 as almost perfect agreement.

Discussion

The descent of the testes starts at the 8th week of intrauterine delivery depending on the nonandrogenic hormone and is completed at the 33rd week by continuing its descent with the androgen-dependent stage and locating in the scrotum. In classical publications, it has been suggested that this second stage continues until the 6th month after birth. Due to delayed descent, the testes can be detected at any location along the developmental pathway from the lower pole of the kidney down to the external inguinal ring. Hence, early examinations by pediatricians have become crucial [14-16].

Radiologic examination of testicles, whose localization could not be identified in physical examination, was started in the 1970s. Publications suggesting that USG does not accurately localize the tests have continued since the 1970s. It is stated that examination is more valuable than research tools in almost every comment in the literature. Institutional bodies express views against the use of USG. Of these, the European Association of Urology, the American Urological Association, and Choosing Wisely Canada stress that USG should not be used [17-19]. The results obtained from our study support these interpretations.

Vos et al. emphasized that they obtained successful outcomes in 61 of 67 patients (91%), and they reduced unnecessary surgical interventions[20-22]. When the cases in our study were evaluated, the fact that the cases were referred to a pediatric surgeon as inguinal pathology demonstrates confusion, indicating that USG was unable to prevent this confusion but rather increased it.

Highlighting the examination under anesthesia, Kamran Fazal et al. emphasized the value of USG. They stated that if the tests are impalpable, USG would be appropriate, and an experienced radiologist could reveal the localization of the tests with more than 90% accuracy. Kullendorff et al. reported that the consistency between physical examination and USG was more than 93% [23,24].

There are also opinions contrary to the conclusion we reached in our study, which states that "it is necessary to question the continuation of USG in testicular localization."

With a distinct perspective, Adesanya et al. pointed out that physical examination has a weaker confirmation rate, and they showed that the accuracy of physical examination was 48.1%, while the accuracy of ultrasound was 86.5%. On the other hand, due to the low sensitivity and accuracy in evaluating localization and testicular viability, authors who oppose USG are dominant. Of these, Wong et al. showed that clinician consensus could be reached only in 34% of cases by USG. Moreover, Snodgrass stated that only 52% of the cases that USG revealed as undescended testes were true undescended testicles [25-27].

In the separate evaluations of Maghnie, Weiss, and Tasian et al., it was suggested that testicular localization using only USG is ineffective, and referring the patient to USG may lead to delays in cases of undescended testes. Weiss et al. added that they could detect the gubernaculum as testes in the evaluation made by USG, and the false positivity was 10% [28-30].

In a meta-analysis by Tasian et al., it was underscored that USG is unreliable, ultrasound performs poorly as a diagnostic test, it cannot even distinguish between nonpalpable and palpable, and the practice is non-academic. Kanaroğlu and Kolon et al. also argued the same view and opposed ordering an examination before the patient was referred [12,18,22,31-33].

The accurate localization, which was determined to be 70% by Weis, was reported to be 85% by Kullendorff et al. Shoukry et al. put forward that even today, it is still necessary to be skeptical about USG, and this imaging technique cannot be recommended to patients despite technological advances [24,33-35].

Similar to our clinical practice, Siobhan Hartigan et al. suggested that radiological examinations, including USG, did not change the surgical treatment modalities. Jaeho Shin, Jedrzejewski, and Lee argued that reliable, objective results to guide surgery could not be obtained [36-39].

In our study, it was revealed that early examinations of pediatricians were more important than radiological examinations. In the radiological examination of the testes that cannot be localized in the physical examination, it was concluded that it would be appropriate to carefully evaluate and eliminate the conditions that may lead to false negative results in the physical examination before the evaluation with USG, and to follow the recommendations of institutional structures such as

the European Association of Urology, American Urological Association and Choosing Wisely Canada. In our study, it was determined that the data to be obtained by USG could not be trusted, even if it was aimed to eliminate parental confusion, and the result that it would cause a delay in actual undescended testes was supported. Moreover, no change was observed in the surgical modality.

In our study, in cases reported to be normal by pediatrics and radiological examinations, a high agreement was found compared to surgical examination, whereas it was found that the agreement was low in cases reported to be abnormal. In the statistical analysis, COHEN's Kappa agreement assessment, and in the final surgical evaluation, the comparison of USG and surgery performed separately for the Pediatric Examination Normal and Abnormal groups were inconsistent. In the agreement evaluation of the case pool where all the cases were collected, USG was able to provide the highest agreement in the pediatric evaluation, although at a moderate level. There was no agreement in the surgery/pediatrics and surgery/USG evaluations, and the findings of fair and slight agreement were obtained, respectively. The findings showed that there was a tendency to report cases as abnormal in radiological examinations and a tendency to report them as normal in surgical evaluations.

Conclusion

Whatever the reason, the popularity of USG does not seem to end. Indication of undescended testes surgery by only USG may cause misinterpretations and may lead to unnecessary surgery decisions. In the evaluation made in our clinic, the findings showed that the number of patients referred for surgery by USG was significantly higher and that some of the cases found in the scrotum on physical examination were seen in the high scrotal or canal on USG. If imaging is to be performed for various reasons, we are of the opinion that it should be USG only in nonpalpable cases, as it is noninvasive, inexpensive, and easily accessible.

Pediatric abnormal findings and USG reports should be confirmed by meticulous examinations. Removing USG from the examination list will not be to the detriment of the patients. We consider that relying on normal pediatric examinations will strengthen the clinician's hand, and relying on abnormal reports on USG may lead the surgeon to make an error. In conclusion, the takeaway lesson should be “trust in examination.”

References

1. Heyns CF, Hutson JM. Historical review of theories on testicular descent. J Urol. 1995 Mar. 153(3 Pt 1):754-67. Doi: 10.1016/S0022-5347(01)67713-9.
2. Kolon TF, Herndon CD, Baker LA,et al. Evaluation and treatment of cryptorchidism: AUA guideline. J Urol. 2014 Aug. 192 (2):337-45. DOI: 10.1016/j.juro.2014.05.005.
3. Park K, Choi H. An Evolution of orchiopexy: Historical aspect. Korean J Urol. 2010 Mar; 51(3): 155–160. doi: 10.4111/kju.2010.51.3.155.
4. Sengul G, Ertekin C. Human cremaster muscle and cremasteric reflex: A comprehensive review. Clinical Neurophysiology. Volume 131, Issue 6, June 2020, Pages 1354-64. Doi: 10.1016/j.clinph.2020.03.011.
5. Jennifer F, Jeremy A, Wendy L. Urology nursing. May 01, 2015 35(3):117-126. DOI: 10.7257/1053-816X.2015.35.3.117.
6. Khan O, Williams G, Boley NB et al. Testicular venography for the localization of the impalpable undescended testes. Br. J. Surg. Vol. 69 (1982) 660. DOİ: 10.1002/bjs.1800691110.
7. Tasian GE, Copp HL, Baskin LS. Diagnostic imaging in cryptorchidism: utility, indications, and effectiveness. J Pediatr Surg. 2011 Dec;46(12):2406-13. doi: 10.1016/j.jpedsurg.2011.08.008.
8. Carpenter CP, Johnston D, Tourville E, et al. Inappropriate imaging for management of cryptorchidism: Has the choosing Wisely® recommendation reduced occurrence? J Pediatr Urol. 2020 Aug;16(4):462.e1-462.e6. doi: 10.1016/j.jpurol.2020.06.017.
9. Selvarajah D, McDowell D, Jehangir S. Unnecessary ultrasound imaging in the management of undescended testes. Med J Aust. 2021 Dec 13;215(11):528. doi: 10.5694/mja2.51324.
10. Mau EE, Leonard MP. Practical approach to evaluating testicular status in infants and children. Can Fam Physician. 2017 Jun; 63(6): 432–435. DOI not available.
11. Hrebinko RL, Bellinger MF. The limited role of imaging techniques in managing children with undescended testes. J Urol. 1993;150:458-60. DOI: 10.1016/s0022-5347(17)35510-6

12. Yu J. Statistical methods for topics involving repeated measures for categorical DATA. P:3. Chapel Hill 2019. https://cdr.lib.unc.edu/downloads/n583z059r Last visited 03rd/06/2022.
13. Rau G, Shih YS. (2021). Evaluation of Cohen's kappa and other measures of interrater agreement for genre analysis and other nominal data. J. English Acad. Purp, 53, 101026. doi:10.1016/j.jeap.2021.101026
14. Titi-Lartey OA, Khan YS. Embryology, Testicle. Treasure Island (FL): StatPearls Publishing; Updated: Apr 28 2022. https://www.ncbi.nlm.nih.gov/books/NBK557763/ Last visited: 07th/06/2022.
15. Hutson JM, Donahoe PK. The hormonal control of testicular descent. Endocr Rev. 1986 Aug. 7(3):270-83. DOI: 10.1210/edrv-7-3-270.
16. Hutson JM, Watts LM. Both gonadotropin and testosterone fail to reverse estrogen-induced cryptorchidism in fetal mice: Further evidence for nonandrogenic control of testicular descent in the fetus. Pediatr Surg Int. 1990. 5:13-18. DOI: 10.1007/BF00179631.
17. European Association of Urology. 2022. Pediatric Urology Guidelines. Page 14.[online] Uroweb. http://uroweb.org/guideline/pediatric-urology/(Last visited on 22 June 2022).
18. Kolon TF, Herndon CDA, Baker LA, Baskin LS, Baxter CG, et al. Evaluation and Treatment of Cryptorchidism: AUA guideline (2018) (Last visited on 22 June 2022). DOI: 10.1016/j.juro.2014.05.005
19. Choosing Wisely Canada [Internet]. Ottawa: Canadian Medical Association. http://www.choosingwiselycanada.org/. (Last visited on 22 June 2022)
20. Wayne C, Guerra LA, Yao J, et al. Use of ultrasound for the palpable undescended testes: a wasteful practice. Family Practice, Volume 35, Issue 4, August 2018, Pages 452–4, https://doi.org/10.1093/fampra/cmx128
21. Vos A, Vries A. M, Smets A, et al. The value of ultrasonography in boys with a nonpalpable testes. Journal of Pediatric Surgery, 49(7), 1153–1155. DOI: 10.1016/j.jpedsurg.2013.09.011
22. Tasian G E. Diagnostic performance of ultrasound in nonpalpable cryptorchidism: A systematic review and meta-analysis. Pediatrics 127(1), 119–128. doi:10.1542/peds.2010-1800.
23. Fazala K, Hussain S, Khan F, et al. To determine the sensitivity, specificity, and diagnostic accuracy of diffusion-weighted MRI in localization of nonpalpable undescended testes taking laparoscopic findings as the gold standard: A cross-sectional study from Pakistan. Ann. Med. Surg. Volume 73, January 2022, 103161. DOI: 10.1016/j.amsu.2021.103161.
24. Kullendorff CM, Hederström E, Forsberg L. Preoperative ultrasonography of the undescended testes. Scand. J. Urol. 1985;19:13–15. DOI: 10.3109/00365598509180215.
25. Adesanya OA, Ademuyiwa AO, Evbuomwan O, et al. Preoperative localization of undescended testes in children: Comparison of clinical examination and ultrasonography. J Pediatr Urol, 10(2), 237–240. DOI:10.1016/j.jpurol.2013.09.023.
26. Wong NC, Bansal RK, Lorenzo AJ, et al. Misuse of ultrasound for palpable undescended testes by primary care providers: a prospective study. Can Urol Assoc J2015; 9: 387–90. DOI: 10.5489/cuaj.3242.
27. Snodgrass W, Bush N, Holzer M, et al. Current referral patterns and means to improve accuracy in diagnosis of undescended testes. Pediatrics 2011; 127: e382–8. DOI:10.1542/peds.2010-1719.
28. Maghnie M, Vanzulli A, Paesano P, et al. The accuracy of magnetic resonance imaging and ultrasonography compared with surgical findings in the localization of the undescended testes. Arch Pediatr Adolesc Med1994; 148: 699–703. DOI: 10.1001/archpedi.1994.02170070037006.
29. Hutson JM, Thorup J. Evaluation and management of the infant with cryptorchidism. Curr Opin Pediatr. 2015 Aug;27(4):520-4. doi: 10.1097/MOP.0000000000000237.
30. Weiss RM, Carter AR, Rosenfield AT. High resolution real-time ultrasonography in localization of the undescended testes. Acta Radiol Diagn (Stockh)1985; 26: 453–456. DOI: 10.1016/s0022-5347(17)45928-3.
31. Tasian GE, Yiee JH, Copp, HL. Imaging use and cryptorchidism: Determinants of practice patterns. The Journal of Urology, 185(5), 1882–1887. DOI: 10.1016/j.juro.2010.12.065
32. Tasian GE, Copp HL, Baskin LS. Diagnostic Imaging in cryptorchidism: utility, indications, and effectiveness J. Pediatr. Surg., 46 (12) (2011), pp. 2406-2413. DOI: 10.1016/j.jpedsurg.2011.08.008
33. Kanaroglou N, To T, Zhu J, et al. Inappropriate use of ultrasound in management of pediatric cryptorchidism. Pediatrics. 2015;136(3):479-486. DOI: 10.1542/peds.2015-0222

34. Christensen JD, Dogra VS. The undescended testes. Semin Ultrasound CT MR. 2007 Aug;28(4):307-16. doi: 10.1053/j.sult.2007.05.007.
35. Shoukry M, Pojak K, Choudhry MS. Cryptorchidism and the value of ultrasonography Ann R Coll Surg Engl 2015; 97: 56–58 doi 10.1308/003588414X14055925058715.
36. Hartigan S, Tasian GE. Unnecessary diagnostic imaging: a review of the literature on preoperative imaging for boys with undescended testes. Transl Androl Urol 2014;3(4):359-364. DOI: 10.3978/j.issn.2223-4683.2014.11.05.
37. Shin J, Jeon GW. Comparison of diagnostic and treatment guidelines for undescended testes. Clin Exp Pediatr > Volume 63(11); 2020. DOI: 10.3345/cep.2019.01438.
38. Jedrzejewski G, Wieczorek AP, Osemlak P, et al. The role of ultrasound in the management of undescended testes before and after orchidopexy - an update. Medicine (Baltimore). 2016 Dec; 95(51): e5731. DOI: 10.1097/MD.0000000000005731
39. Lee SW, Kim KS, Chang HS, et al. Comprehension and practice patterns toward cryptorchidism in Korean Urologists. Korean J Urol 2009;50:169–78. DOI: 10.3346/jkms.2022.37.e98.