IJMA

International Journal of Medical Arts

Volume 6, Issue 10, October 2024

P- ISSN: 2636-4174
E- ISSN: 2682-3780

Available online at Journal Website
https://ijma.journals.ekb.eg/
Main Subject [Pediatric Surgery]

Original Article

Timing of Orchidopexy; Efficacy and Safety Outcomes in Patients with Cryptorchidism: Systematic Review and Meta-Analysis

Mohammed Abd El kader Hamdy *, Mohamed Mohamed Shahin, Yasser Ashour Mohammed, Mohamed Anwar

Department of Pediatric Surgery, Damietta Faculty of Medicine, Al-Azhar University, Damietta, Egypt.

Article information

Received: 02-09-2024

Accepted: 13-10-2024

DOI: 10.21608/ijma.2024.317706.2027.

*Corresponding author

Email: mohahelal1995@gmail.com

Citation: Hamdy MA, Shahin M, Mohammed YA, Anwar M. Timing of Orchidopexy; Efficacy and Safety Outcomes in Patients with Cryptorchidism: Systematic Review and Meta-Analysis. IJMA 2024; October; 6 [10]: 4976-4983. DOI: 10.21608/ijma.2024.245532.1850.

Abstract

Background: Cryptorchidism, or undescended testes, is the most common congenital anomaly in newborn males, with a prevalence of 2% to 9% in full-term infants. There is a current debate regarding the optimal time to perform orchidopexy.

Methods: We searched PubMed, Scopus, and Web of Science [August 2024] using terms relating to cryptorchidism, orchidopexy, and the outcomes of interest. The primary outcome was the incidence of testicular atrophy. Secondary outcomes included preoperative and postoperative testicular volume, the number of spermatogonia per tubule, and seminiferous tubular diameter. Data were analyzed using fixed- or random-effect models based on the presence of heterogeneity.

Results: Nine studies involving 5,494 patients were included. There was no significant difference in the incidence of testicular atrophy between early and late orchidopexy groups [OR = 0.92, 95% CI [0.44 to 1.94], p = 0.83]. Early orchidopexy was associated with a significantly higher number of spermatogonia per tubule [mean difference [MD] = 0.47, 95% CI [0.33 to 0.60], p = 0.00] and greater seminiferous tubular diameter [MD = 9.92, 95% CI [3.34 to 16.40], p = 0.11].

Conclusion: Early orchidopexy had been suggested to offer better fertility outcomes. However, the current work showed that the timing of orchidopexy may not be critical in preventing testicular atrophy.

Keywords: Undescended Testis; Surgical Timing; Pediatrics; Urology.

INTRODUCTION

Among newborn boys, the most common congenital anomaly is the incomplete descent of the testes. Full-term newborns have a prevalence of between 2% and 9%, which declines with age because of spontaneous descent [1-5].

Long-term complications linked to cryptorchidism include infertility and an elevated risk of testicular cancer [6]. Even after a successful surgical correction, there is evidence that the chance of failed attempts at paternity is high in the unilateral and up to 6-fold in the bilateral cryptorchid group when compared to a control group of patients with normally descended testes [7].

Orchidopexy is the standard management for cryptorchidism as it prevents testicular damage that can impair testicular function and improve fertility outcomes [6].

A consensus statements was released by several medical associations recommend orchidopexy before age of 12 months and the British Association of Pediatric Urologists recommends performing orchidopexy before the age of 3 months, with surgery between 6 and 12 months of age also considered appropriate [8-11]. Despite this, the optimal time of orchidopexy is not universally agreed upon, and timing for orchidopexy in cryptorchidism is controversial, especially when estimating future fertility potential [12, 13].

Also, the number of spermatogonia per tubule and tubular diameter were used by several studies to assess fertility outcomes in children undergoing orchidopexy before 12 months of age [early orchidopexy] or after 12 months of age [late orchidopexy] [12, 14, 15]. However, there is a significant conflict between studies regarding these outcomes.

Chan *et al.* [16] conducted a review that supports the decision for early orchidopexy. However, this review was designed to support mere early orchidopexy without considering any particular age cut-off.

On the other hand, **Allin *et al.*** [17] conducted a meta-analysis examining the effect of early vs. late orchidopexy, defining early as before 12 months and late as after 12 months. However, they did not include postoperative volume in their analysis, and additional evidence has emerged since their study.

We conducted this meta-analysis to compare testicular atrophy, preoperative and postoperative testicular volumes, the number of spermatogonia per tubule, and tubular diameter in patients undergoing early [≤ 12 months of age] vs. late [> 12 months of age] orchidopexy.

METHODS

We conducted this systematic review and meta-analysis following the PRISMA and Cochrane Handbook guidelines [18].

Randomized controlled trials and observational studies, compared orchidopexy before the age of 12 months as the interventional group and orchidopexy after the age of 12 months in patients with unilateral or bilateral cryptorchidism were included in our study. We excluded studies on animals, non-English publications, unpublished data, and conference abstracts.

This review focused on patients who had undergone orchidopexy and been diagnosed with unilateral or bilateral cryptorchidism.

We considered testicular atrophy as our primary outcome. Secondary outcomes included preoperative and postoperative testicular volume, the number of spermatogonia per tubule, and the diameter of seminiferous tubules.

Using this search query: ["ascending testes" OR "undescended testes" OR cryptorchidism] AND ["orchidopexy" OR orchidopexy] AND ["testicular atrophy" OR "testicular cancer" OR "testicular neoplasms" OR fertility OR infertility] OR ["Child Development" OR "Developmental Disabilities" OR "Neurodevelopment" OR "Neurodevelopmental Disorders" OR "Musculoskeletal Development" OR "Human Development" OR development], a thorough literature search was performed on PubMed, Scopus, and Web of Science [August 2024].

We employed a two-step process to screen the literature. We conducted abstract and title screening and then full-paper screening for studies that met our inclusion criteria throughout title and abstract screening.

We extracted and recorded data from the included studies on a standard extraction sheet. We categorized the data into three main aspects: Characteristics of the population and included studies, Risk of bias domains, and Outcome measures, which included testicular atrophy, preoperative testicular volume, postoperative testicular volume, the number of spermatogonia per tubule, and the tubular diameter of seminiferous tubules.

We pooled the frequency of events and the total number of testes in each group, using the Mantel-Haenszel fixed-effect model, to calculate the odds ratio [OR] and its 95% confidence interval [CI] for testicular atrophy, which involved dichotomous data. A p-value of less than 0.05 was considered statistically significant. For continuous outcomes, we calculated the mean differences and 95% CIs. The usage of a fixed-effect or random-effects model was based on heterogeneity, assessed using the I-square statistic. A random-effects model was applied if I-square was greater than 50%, indicating substantial heterogeneity; otherwise, a fixed-effect model was used. Statistical analyses were performed with STATA statistical software.

We used the Chi-square test, also known as the Cochrane Q test, to assess for statistical heterogeneity. Then, I-squared was calculated using the Chi-square statistic, Cochrane Q. Significant heterogeneity was defined as a Chi-square P value of less than 0.1. I-square values of more than 50% were regarded as highly heterogeneous. In addition, the Galbraith plot was employed to identify any heterogeneity across pooled studies of the primary outcome.

We used the Cochrane RoB 2 tool for randomized controlled trials to evaluate the quality of the included trials [19]. The selection, performance, detection, attrition, and reporting bias domains are the five domains in which bias risk is evaluated by this tool. A "High risk of bias," "Some concerns," or "Low risk of bias" was assigned to each study. We employed the Newcastle–Ottawa Scale [NOS] for observational studies, which assesses studies according to three domains: outcome, comparability, and selection [20].

RESULTS

Literature Search: We included nine studies in our meta-analysis after abstract, title, and full-text screening from the 2,539 papers yielded by our search across the three databases. **Figure [1],** the PRISMA flow diagram, depicts the flowchart of the included studies.

Characteristics of Included Studies: We included nine studies with a total of 1,525 undescended testes in our analysis. Seven of the included studies were observational [6, 12, 14, 21-24] and only two studies [of the same population] were randomized controlled trials [1, 25]. **Table [1]** summarizes the baseline characteristics of the included studies.

Risk of Bias Assessment: We used Cochrane RoB 2 and NOS to evaluate the risk of bias. Both of the included RCTs were from the same population and had an overall high risk of bias. Observational studies were assessed using NOS, and three out of seven studies showed good quality, as shown in **Table [2].**

Clinical Outcomes

Testicular Atrophy: Testicular atrophy, our main endpoint, was evaluated in four studies [14, 21, 22, 24] . The incidence rate for the early orchidopexy group was 5.17% [9 of 174], while the late orchidopexy group had a higher incidence rate of 5.34% [41 of 767]. The combined OR did not show a statistically significant difference in testicular atrophy between the two groups [OR = 0.92, 95% CI [0.44 to 1.94], p = 0.83]; the pooled studies were homogeneous [I^2 = 0.00%, p = 0.62], as indicated by **Figure [2].** As demonstrated in **Figure [3],** we used the Galbraith plot to test statistical heterogeneity. All studies fell within the 95% CI of the precision area, suggesting that there was no heterogeneity across the studies.

Secondary Outcomes

There was no significant difference between early orchidopexy and late orchidopexy regarding postoperative testicular volume [mean difference [MD] = -0.11, 95% CI [-0.56 to 0.34], p = 0.65] [1] [23] or preoperative testicular volume [MD = -0.06, 95% CI [-0.22 to 0.11], p = 0.51] [6] [23] [25]; the pooled studies were not homogeneous with the following values, respectively [I^2 = 96.42%, p = 0.00; and I^2 = 93.15%, p = 0.00], as shown in **Figures [4 and 5].**

However, our pooled analysis showed a superior effect of early orchidopexy compared to late orchidopexy regarding the number of spermatogonia per tubule [MD = 0.47, 95% CI [0.33 to 0.60], p = 0.00] [6, 12, 14] and tubular diameter of seminiferous tubules [MD = 9.92, 95% CI [3.34 to 16.40], p = 0.11] [6, 14, 25]. The number of spermatogonia per tubule pooled studies were homogeneous [I^2 = 49.91%, p = 0.14], but the pooled studies of the tubular diameter of seminiferous tubules were not homogeneous [I^2 = 91.28%, p = 0.00], as shown in **Figures [6 and 7].**

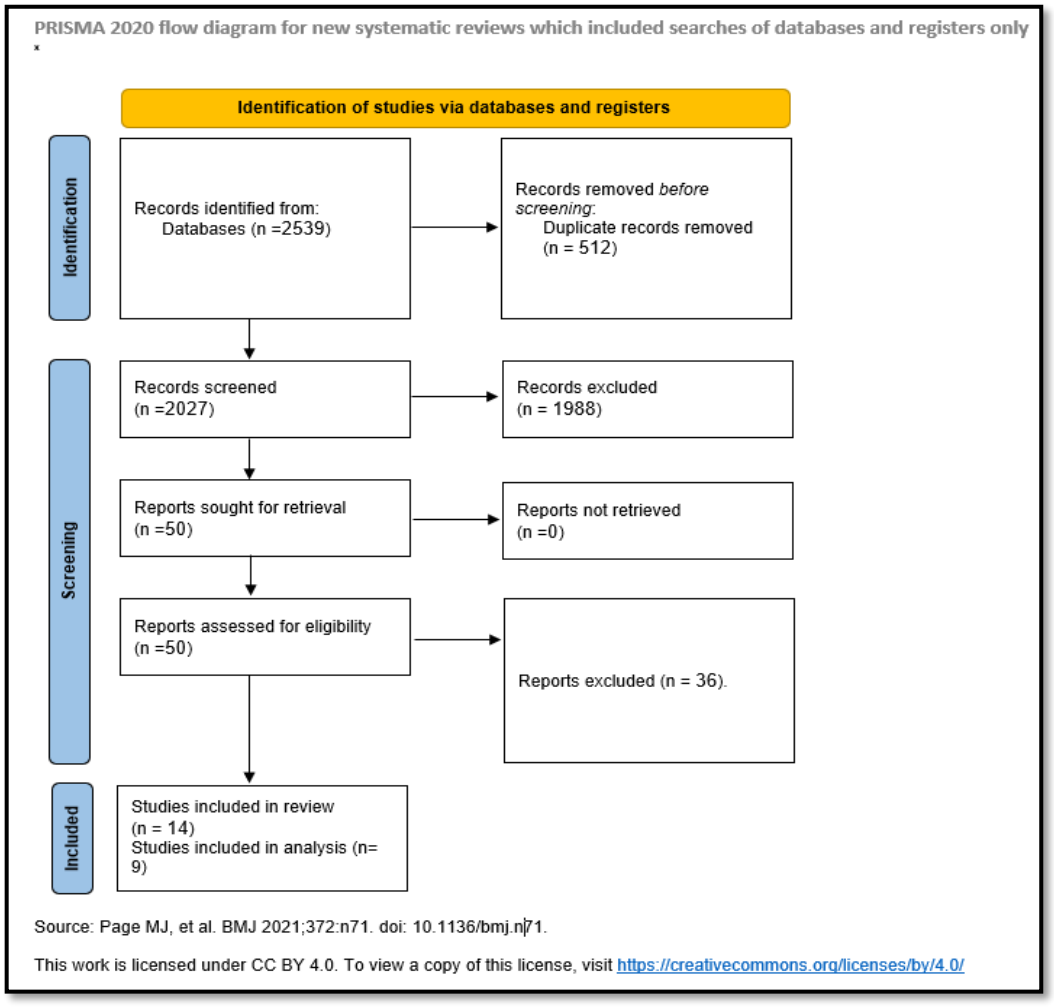

Figure [1]: PRISMA flow diagram

Table [1]: Summary characteristics of the included studies in the analysis.

Study title	Study type	Age at orchidopexy		No. of testes*		Number of intrabdmoinal tastes	Outcomes reported
		Intervention	Comparator	Intervention	Comparator		
Kogan 1990	Prospective cohort	<12 months	12–46 months	13	64	0 [0]	Postoperative complication, testicular atrophy, testicular retraction, anesthetic complication, mean seminiferous tubule diameter, mean number of germ cells per tubule
McAleer1995	Retrospective cohort study	<12 months	1–16 years	51‡	189‡	25 [9·3] in entire cohort	Fertility index [mean number of spermatogonia per tubule]
Kollin 2012	RCT	9 months	3 years	127¶	92¶	Intervention group 22 [17·3] Control group 10 [11]	Mean testicular volume at surgery, Sertoli cells per 100 cords, germ cells per 100 cords, cord diameter, percentage interstitial tissue, serum FSH, LH, inhibin B and testosterone levels
Kollin 2013	Follow-up of Kollin 2012	9 months	3 years	[78]#	[85]#	n.r. [assumed the same as Kollin et al. 25]	Testicular volume at follow-up
Park 2007	Retrospective cohort	<12 months	>12 months	20 [20]	45 [45]	n.r.	Number of germ cells per tubule, interstitial peritubular fibrosis, mean tubular fertility index, germ cell count, testicular volume at surgery, mean tubular diameter, Sertoli cell index
Carson 2014	Retrospective cohort study	<12 months	1–16 years	64	285	50 [14·3] in entire cohort	Testicular atrophy, postoperative complications
ORCHESTRA 2021	Prospective cohort study	<12 months	≥12 months	39 [39]	303 [303]	0 [0]	Postoperative testicular atrophy
Tseng 2017	Retrospective cohort study	≤12 months	>12 months	84 [58]	149 [124]	n.r.	PreOP UDT volume, PostOP UDT volume, Growth Percentage of UDT, PreOP NDT volume, PostOP NDT volume, Growth Percentage of NDT, Growth Percentage Ratio [UDT/NDT]

Values in parentheses are *number of infants and †percentage of total testes unless indicated otherwise. ‡A total of 268 testes were recruited, but only 240 were analyzed in primary study owing to inadequacy of samples; ¶number of testes per group clear, but number of infants in each group unclear; #exact numbers of patients and testes unclear as text differs from tables. UDT: undescended testis; NDT: normal descended testis.

Table [2]: NOS scale for observational studies

Study Title	Selection				Comparability	Outcome			Quality score
	Representativeness of the exposed cohort	Selection of the non-exposed cohort	Ascertainment of exposure	Demonstration that outcome of interest was not present at start of study	Comparability of cohorts on the basis of the design or analysis	Assessment of outcome	Was follow-up long enough for outcomes to occur	Adequacy of follow up of cohorts	
Tseng 2017	*	*	*	*	*	*	*	*	good
ORCHESTRA	*	*	*		*	*			poor
Tseng 2019	*	*	*			*	*	*	poor
Park 2007	*	*	*	*	*	*	*	*	good
McAleer 1995	*	*	*	*		*	*	*	poor
Carson 2014	*	*	*	*		*	*	*	poor
Kogan 1990	*	*	*	*	*	*		*	good

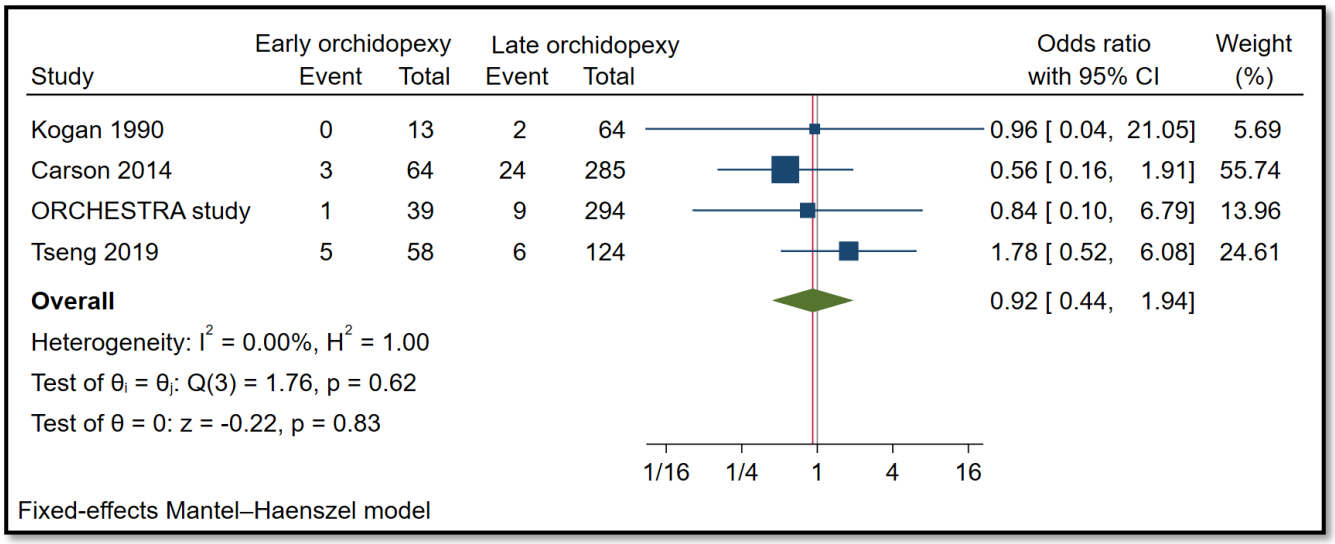

Figure [2]: Forest plot comparing testicular atrophy in boys with cryptorchidism who underwent orchidopexy at less than 1 year of age with those who had the operation at or after the age of 1 year. A Mantel–Haenszel fixed-effect model was used. Risk ratios are shown with 95 per cent confidence intervals

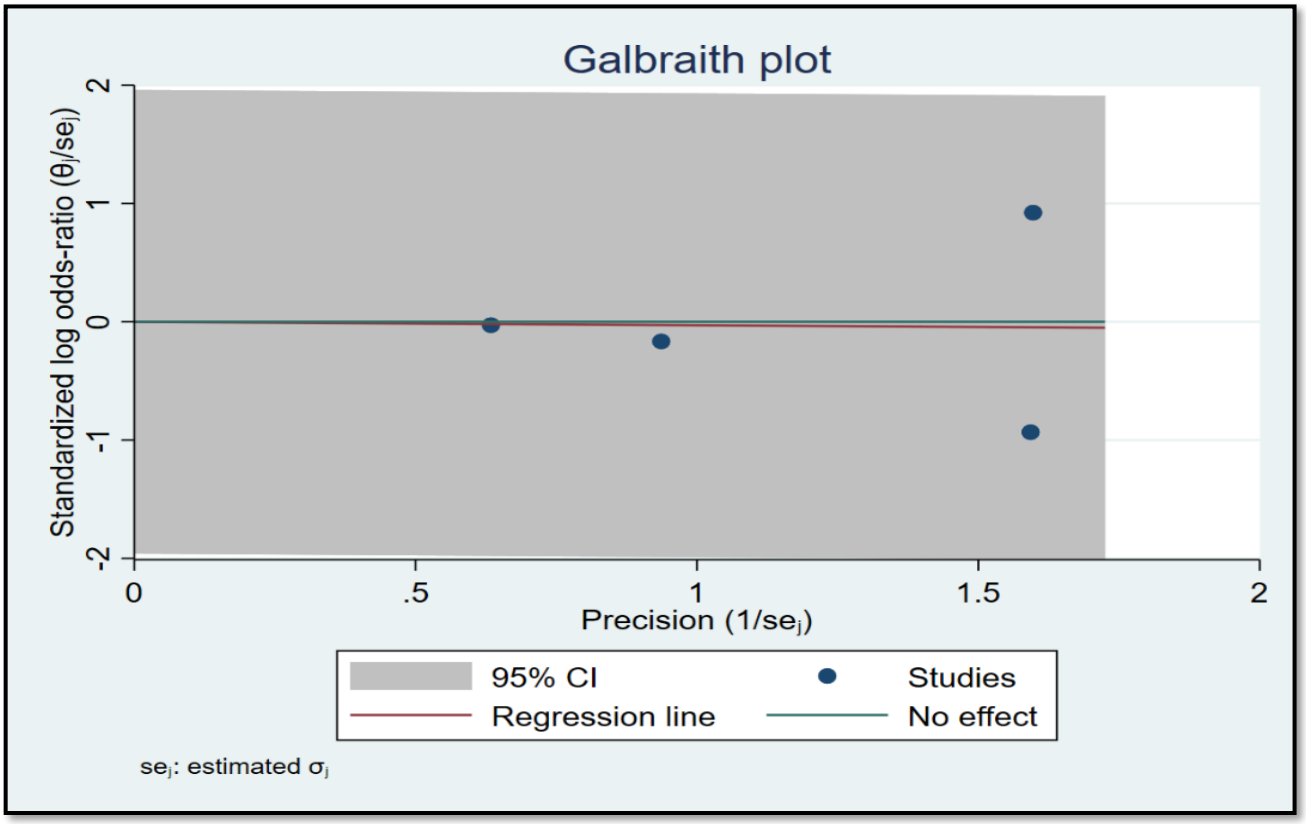

Figure [3]: Galbraith plot assessing heterogeneity across studies assessed testicular atrophy

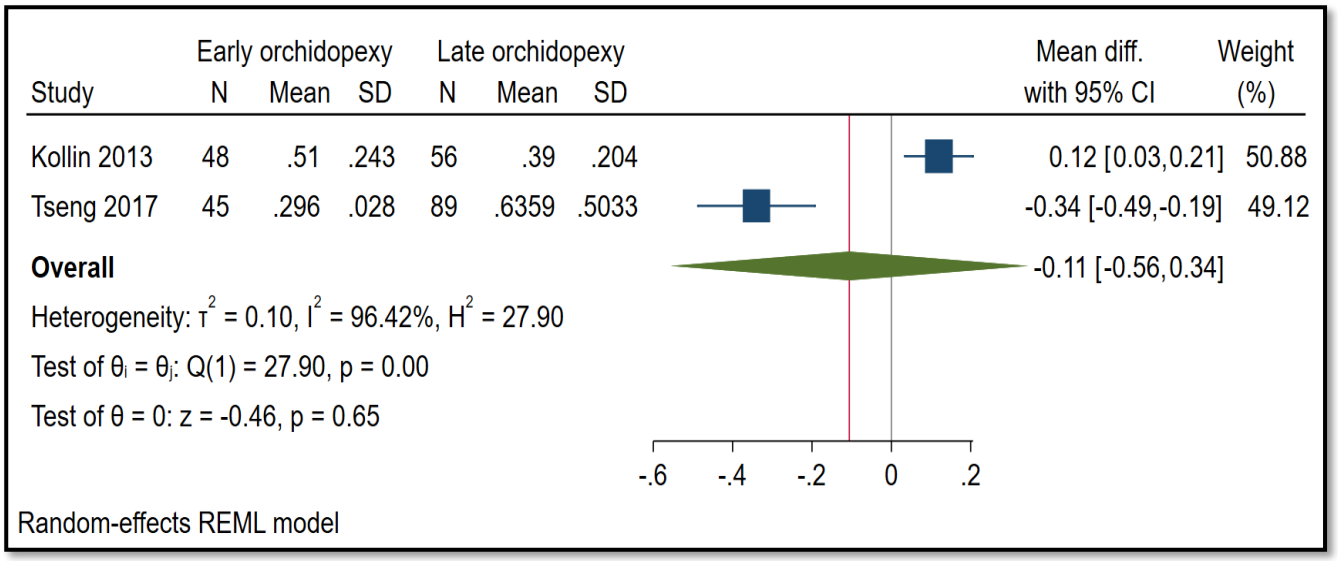

Figure [4]: Forest plot comparing postoperative testicular volume in boys with cryptorchidism who underwent orchidopexy at less than 1 year of age with those who had the operation at or after the age of 1 year. An inverse-variance random-effects model was used. Mean differences are shown with 95 per cent confidence interval

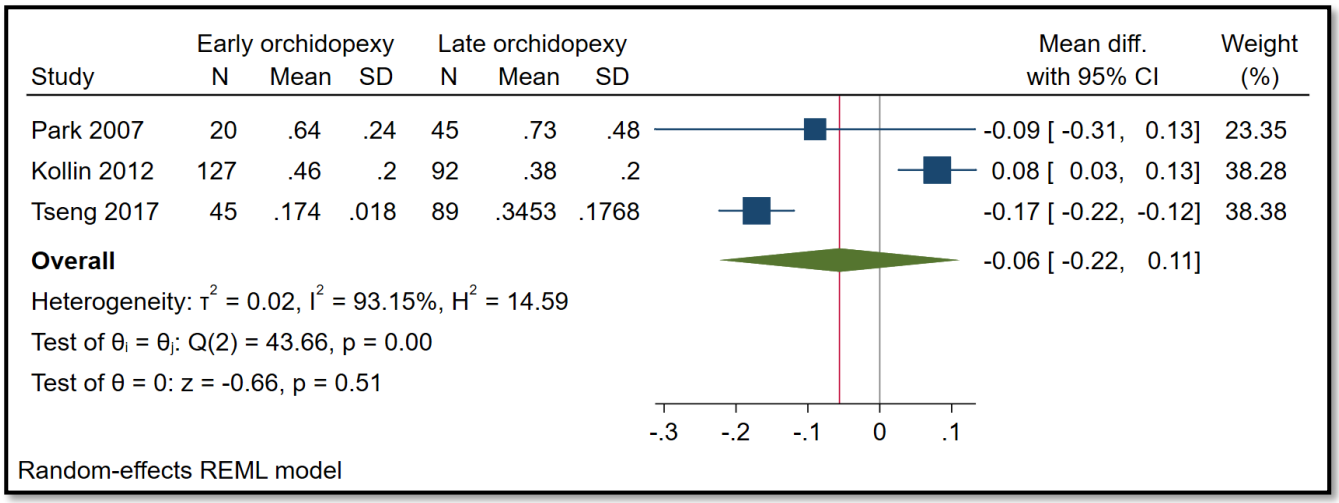

Figure [5]: Forest plot comparing preoperative testicular volume in boys with cryptorchidism who underwent orchidopexy at less than 1 year of age with those who had the operation at or after the age of 1 year. An inverse-variance random-effects model was used. Mean differences are shown with 95 per cent confidence intervals

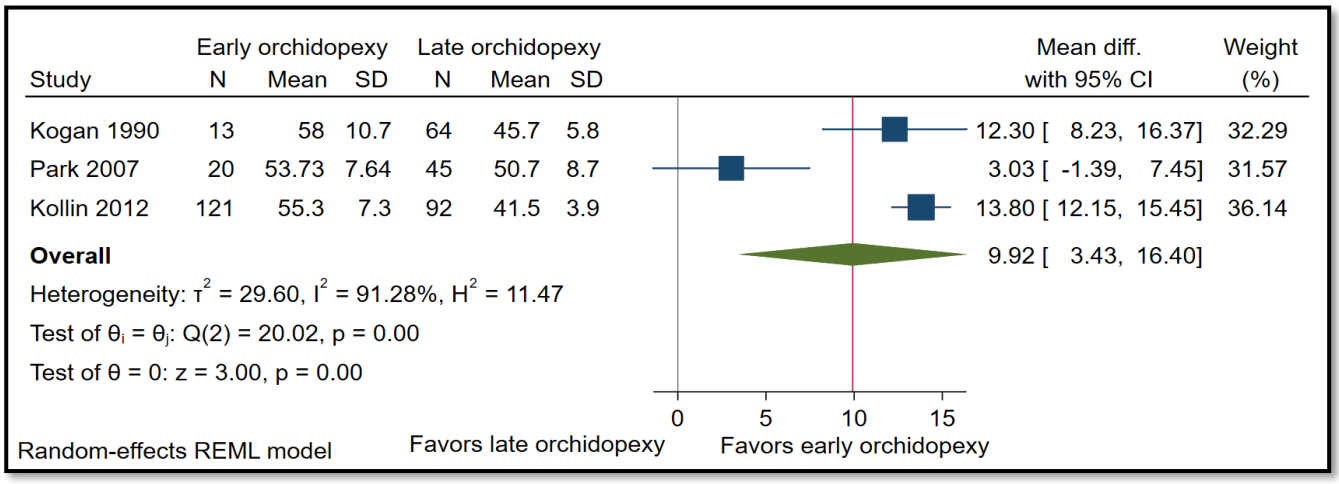

Figure [6]: Forest plot comparing tubular diameter in boys with cryptorchidism who underwent orchidopexy at less than 1 year of age with those who had the operation at or after the age of 1 year. An inverse-variance random-effects model was used. Mean differences are shown with 95 per cent confidence intervals

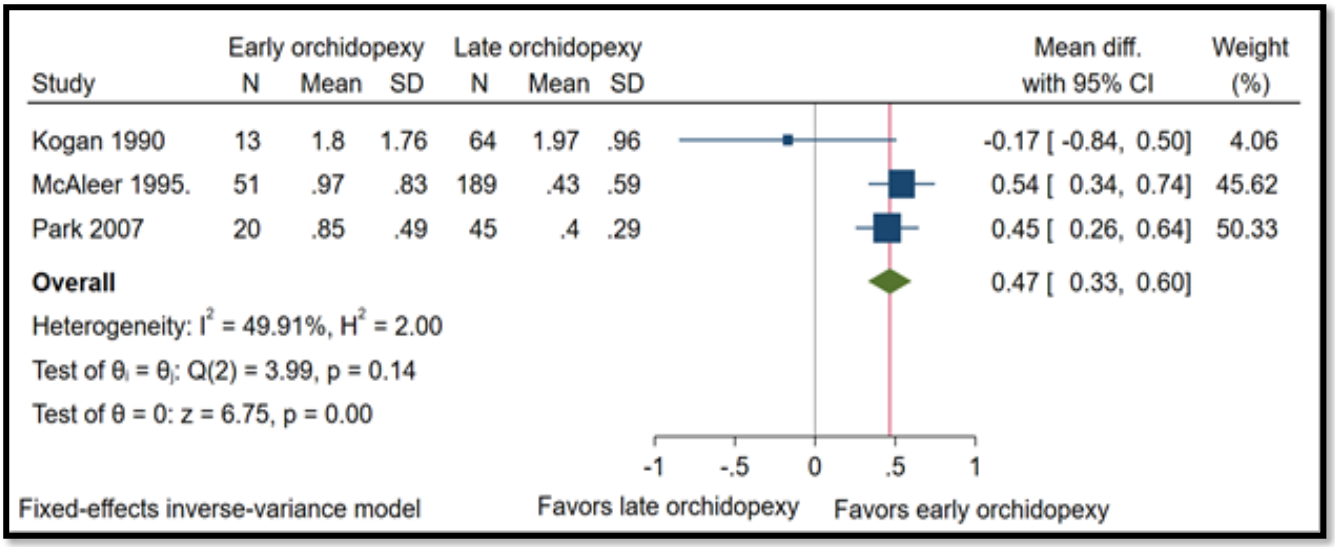

Figure [7]: Forest plot comparing the number of spermatogonia per tubule in boys with cryptorchidism who underwent orchidopexy at less than 1 year of age with those who had the operation at or after the age of 1 year. An inverse-variance fixed-effect model was used. Mean differences are shown with 95 per cent confidence intervals.

DISCUSSION

The study showed that there was no difference between early vs. late orchidopexy regarding testicular atrophy, preoperative, and postoperative testicular volume, but there was a statistically significant difference regarding the number of spermatogonia per tubule and tubular diameter of seminiferous tubules. Previous studies showed similar results with no conflict regarding testicular atrophy. However, **Kollin *et al.*** showed a positive association between early orchidopexy and higher preoperative and postoperative testicular volumes, respectively. However, there was a difference in the percentage of patients with intra-abdominal testes in the compared groups, which might have been a confounder in these results [1, 25]. In fact, in **Carson *et al.*,** their initial results showed an association between age at orchidopexy and rates of testicular atrophy. However, when they adjusted for the location of the undescended testes, there was no longer any association between age at orchidopexy and rates of testicular [21]. So, the location of the undescended testis might have affected the outcome of testicular volumes in **Kollin *et al.*** as well. Additionally, Kogan et al. and Park et al. linked early orchidopexy to a smaller number of spermatogonia per tubule and tubular diameter of seminiferous tubules, respectively [14] [6]. However, the number of testes in the intervention group was much smaller than the control group, which may not be representative of the real mean value in the population of early orchidopexy.

Limitations*:*

The results of this study may suggest that early orchidopexy has better fertility outcomes compared to late orchidopexy. However, the included studies have several limitations. All of them, except Kollin *et al.* [with a high risk of bias], are observational studies. Another main limitation is the unbalanced testicular locations between intervention and control groups. Many of the included studies did not report the location of undescended testes, making it difficult to know whether they accounted for the effect of location on fertility or not [6, 22, 23].

As mentioned previously, when Carson *et al.* adjusted [according to testicular location] the positive association [between early orchido-pexy and fertility], the results became statistically insignificant [21].

Another limitation is the discrepancy in the definition of testicular atrophy. For example, the ORCHESTRA study assessed testicular atrophy 6 months after orchidopexy, while most of the included studies assessed atrophy perioperatively [14,21 24]. Another limitation is that none of the included studies assessed testicular malignancy between the cohorts of the two interventions. Although there is evidence of increased developmental complications in children receiving anesthesia, the data was insufficient to compare anesthetic complications. **LaLa *et al.*** reported anesthetic complications, but the cohort of this study did not meet our inclusion criteria as they compared patients <12 months [whether they failed LH and HCG therapy or not] with patients >12 months, after failed LH and HCG therapy [26]. Our study is not the first to compare early vs. late orchidopexy. **Allin *et al.*** showed results similar to our meta-analysis, but they linked early orchidopexy to a larger preoperative testicular volume [17]. This conflict might be because they included **Canavese *et al.*** and **Feyles *et al.*** However, we excluded both studies due to the discrepancy of using LH and HCG between the intervention and control groups [27, 28]. Additionally, we are the first to pool postoperative testicular volume. Although a recent follow-up study by **Kollin *et al.*** reported postoperative testicular volumes of a previously recruited cohort at ages 11 and 16 years, we did not include this study because there is more than a 10-year difference between the age of Kollin et al. 2024 and our pooled studies, which may introduce more heterogeneity [29].

Conclusion: Although the pooled outcomes of this study may indicate better outcomes of early orchidopexy, there is significant heterogeneity between the included studies that does not ensure robust evidence of this assumption. We recommend the future multiple randomized controlled trials to reach solid evidence regarding the safety and efficacy of early orchidopexy in comparison to late orchidopexy.

Disclosure: None to be disclosed

REFERENCES

1. Kollin C, Granholm T, Nordenskjöld A, Ritzén EM. Growth of Spontaneously Descended and Surgically Treated Testes During Early Childhood. Pediatrics [Internet]. 2013 Apr 1;131[4]:e1174–80. doi:10.1542/peds.2012-2902
2. Bay K, Main KM, Toppari J, Skakkebæk NE. Testicular descent: INSL3, testosterone, genes and the intrauterine milieu. Nat Rev Urol. 2011 Apr;8[4]:187–96. doi:10.1038/nrurol.2011.23
3. Thong M, Lim C, Fatimah H. Undescended testes: incidence in 1,002 consecutive male infants and outcome at 1 year of age. Pediatr Surg Int. 1998 Jan;13[1]:37–41. doi:10.1007/s003830050239
4. Berkowitz GS, Lapinski RH, Dolgin SE, Gazella JG, Bodian CA, Holzman IR. Prevalence and natural history of cryptorchidism. Pediatrics. 1993 Jul;92[1]:44–9.
5. Virtanen HE, Toppari J. Epidemiology and pathogenesis of cryptorchidism. Hum Reprod Update. 2008;14[1]:49–58. doi:10.1093/humupd/dmm027
6. Park KH, Lee JH, Han JJ, Lee SD, Song SY. Histological evidences suggest recommending orchiopexy within the first year of life for children with unilateral inguinal cryptorchid testis. Int J Urol [Internet]. 2007 Jul 7;14[7]:616–21. doi:10.1111/j.1442-2042.2007.01788.x
7. Lee PA, Coughlin MT. Fertility after bilateral cryptorchidism. Evaluation by paternity, hormone, and semen data. Horm Res. 2001;55[1]:28–32. doi:10.1159/000049960
8. Lee B, Featherstone N, Nagappan P, McCarthy L, O'Toole S. British Association of Paediatric Urologists consensus statement on the management of the neuropathic bladder. J Pediatr Urol. 2016 Apr;12[2]:76–87. doi:10.1016/j.jpurol.2016.01.002
9. Kolon TF, Herndon CDA, Baker LA, Baskin LS, Baxter CG, Cheng EY, Diaz M, Lee PA, Seashore CJ, Tasian GE, Barthold JS. Evaluation and treatment of cryptorchidism: AUA guideline. J Urol. 2014 Aug;192[2]:337–45. doi:10.1016/j.juro.2014.05.005
10. Ritzén EM, Bergh A, Bjerknes R, Christiansen P, Cortes D, Haugen SE, et al. Nordic consensus on treatment of undescended testes. Acta Paediatr. 2007;96[5]:638–43. doi:10.1111/j.1651-2227.2006.00159.x
11. Radmayr C, Dogan HS, Hoebeke P, Kocvara R, Nijman R, Silay S, Stein R, Undre S, Tekgul S. Management of undescended testes: European Association of Urology/European Society for Paediatric Urology Guidelines. J Pediatr Urol. 2016 Dec;12[6]:335–43. doi:10.1016/j.jpurol.2016.07.014
12. McAleer IM, Packer MG, Kaplan GW, Scherz HC, Krous HF, Billman GF. Fertility Index Analysis in Cryptorchidism. J Urol [Internet]. 1995 Apr;153[4]:1255–8. doi:10.1016/S0022-5347[01]67580-3
13. Steckler RE, Zaontz MR, Skoog SJ, Rushton HGJ. Cryptorchidism, pediatricians, and family practitioners: patterns of practice and referral. J Pediatr. 1995;127[6]:948–51. doi:10.1016/s0022-3476[95]70034-x
14. Kogan SJ, Tennenbaum S, Gill B, Reda E, Levitt SB. Efficacy of Orchiopexy by Patient Age 1 Year for Cryptorchidism. J Urol [Internet]. 1990 Aug;144[2 Part 2]:508–9. doi:10.1016/S0022-5347[17]39505-8
15. Bostofte E, Serup J, Rebbe H. Relation between sperm count and semen volume, and pregnancies obtained during a twenty-year follow-up period. Int J Androl. 1982 Jun;5[3]:267–75. doi:10.1111/j.1365-2605.1982.tb00255.x
16. Chan E, Wayne C, Nasr A. Ideal timing of orchiopexy: a systematic review. Pediatr Surg Int. 2014 Jan;30[1]:87–97. doi:10.1007/s00383-013-3429-y
17. Allin BSR, Dumann E, Fawkner-Corbett D, Kwok C, Skerritt C. Systematic review and meta-analysis comparing outcomes following orchidopexy for cryptorchidism before or after 1 year of age. BJS open. 2018 Feb;2[1]:1–12. doi:10.1002/bjs5.36
18. Liberati A, Altman DG, Tetzlaff J, Mulrow C, Gøtzsche PC, Ioannidis JPA, Clarke M, Devereaux PJ, Kleijnen J, Moher D. The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate healthcare interventions: explanation and elaboration. BMJ [Internet]. 2009 Jul 21;339:b2700. doi:10.1136/bmj.b2700
19. Sterne JAC, Savović J, Page MJ, Elbers RG, Blencowe NS, Boutron I, et al. RoB 2: a revised tool for assessing risk of bias in randomised trials. BMJ. 2019 Aug;366:l4898. doi:10.1136/bmj.l4898
20. Lo CKL, Mertz D, Loeb M. Newcastle-Ottawa Scale: comparing reviewers' to authors' assessments. BMC Med Res Methodol. 2014 Apr;14:45. doi:10.1186/1471-2288-14-45
21. Carson JS, Cusick R, Mercer A, Ashley A, Abdessalam S, Raynor S, Lyden E, Azarow K. Undescended testes: Does age at orchiopexy affect survival of the testis? J Pediatr Surg [Internet]. 2014 May;49[5]:770–3. doi:10.1016/j.jpedsurg.2014.02.065
22. Tseng CS, Huang KH, Kuo MC, Hong CH, Chen CH, Lu YC, Huang CY, Pu YS, Chang HC, Chiang IN. The impact of primary location and age at orchiopexy on testicular atrophy for congenital undescended testis. Sci Rep [Internet]. 2019 Jul 1;9[1]:9489. doi:10.1038/s41598-019-45921-6
23. Tseng CS, Chiang IN, Hong CH, Lu YC, Hong JH, Chang HC, Huang KH, Pu YS. Advantage of early orchiopexy for undescended testis: Analysis of testicular growth percentage ratio in patients with unilateral undescended testicle. Sci Rep [Internet]. 2017 Dec 12;7[1]:17476. doi:10.1038/s41598-017-17825-w
24. Skerritt C, Bradshaw C, Hall N, McCarthy L, Woodward M. Timing of orchidopexy and its relationship to postoperative testicular atrophy: results from the ORCHESTRA study. BJS Open [Internet]. 2021 Jan 8; 5[1]. doi:10.1093/bjsopen/zraa052
25. Kollin C, Stukenborg JB, Nurmio M, Sundqvist E, Gustafsson T, Söder O, Toppari J, Nordenskjöld A, Ritzén EM. Boys with Undescended Testes: Endocrine, Volumetric and Morphometric Studies on Testicular Function before and after Orchidopexy at Nine Months or Three Years of Age. J Clin Endocrinol Metab [Internet]. 2012 Dec 1;97[12]:4588–95. doi:10.1210/jc.2012-2325
26. Lala R, Matarazzo P, Chiabotto P, Gennari F, Cortese MG, Canavese F, de Sanctis C. Early hormonal and surgical treatment of cryptorchidism. J Urol. 1997 May;157[5]:1898–901.
27. Feyles F, Peiretti V, Mussa A, Manenti M, Canavese F, Cortese M, Lala R. Improved Sperm Count and Motility in Young Men Surgically Treated for Cryptorchidism in the First Year of Life. Eur J Pediatr Surg [Internet]. 2013 Jul 12;24[05]:376–80. doi:10.1055/s-0033-1349715
28. Canavese F, Cortese MG, Magro P, Lonati L, Teruzzi E, de Sanctis C, Lala R. Cryptorchidism: medical and surgical treatment in the 1st year of life. Pediatr Surg Int [Internet]. 1998 Nov 24; 14[1–2]:2–5. doi:10.1007/s003830050422
29. Kollin C, Nordenskjöld A, Ritzén M. Testicular volume at puberty in boys with congenital cryptorchidism randomised to treatment at different ages. Acta Paediatr [Internet]. 2024 Aug 11; 113[8]:1949–56. doi:10.1111/apa.17270.

IJMA

International Journal of Medical Arts

Volume 6, Issue 10, October 2024

P- ISSN: 2636-4174
E- ISSN: 2682-3780