

Determinants of Primary Orchiopexy Failure in Children: A 5-Year Retrospective Cohort from a Kenyan Tertiary Hospital

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Abstract

Background: Cryptorchidism is a common congenital condition, and orchiopexy is the standard treatment for persistent undescended testis. This study assessed primary orchiopexy failure and associated factors at a Kenyan county referral hospital. **Methods:** We conducted a retrospective cohort study at Kiambu Level 5 Hospital, Kenya, covering January 2018 to December 2022. The study included 78 children undergoing 90 primary orchiopexies. Failure was defined as re-ascent, testicular atrophy, or repeat orchiopexy. Generalized estimating equations were used to account for clustering of testes within children. **Results:** Median age at surgery was 4.5 years (IQR 2.5 - 7.0), and 12/90 procedures (13.3%) met the failure definition. Failures comprised re-ascent (7/12, 58.3%), atrophy (3/12, 25.0%), and repeat orchiopexy (2/12, 16.7%). In the multivariable model, bilateral cryptorchidism (OR 2.1, 95% CI 1.1 - 4.0; $p = 0.032$), high inguinal position (OR 2.9, 95% CI 1.3 - 6.5; $p = 0.008$), and intra-abdominal position (OR 4.1, 95% CI 1.7 - 9.9; $p = 0.002$) were associated with failure. **Conclusion:** Primary orchiopexy failure occurred in 13.3% of procedures. Bilateral disease and higher testicular position were associated with increased odds of failure. Earlier referral and careful operative planning for high-positioned testes warrant attention.

Keywords

Cryptorchidism, Orchiopexy, Surgical Outcomes, Re-Ascent, Testicular Atrophy, Kenya

1. Introduction

Cryptorchidism, or undescended testis (UDT), is a common congenital abnor-

mality of the male reproductive system. Spontaneous descent occurs mainly during early infancy, and persistent undescended testes should be assessed and treated according to established paediatric urology guidance [1]-[5]. Early surgical correction is recommended to support testicular development and reduce, but not eliminate, longer-term risks [4]-[6].

Orchiopexy is the standard surgical treatment for persistent UDT. Reported outcomes vary with testicular position, operative approach, case selection, and the definition and duration of follow-up; re-ascent and testicular atrophy are recognized adverse outcomes [7]-[9]. Higher or nonpalpable testes may require more extensive mobilization and specialized approaches [8] [9].

In low- and middle-income countries (LMICs), delayed presentation and limited access to paediatric surgical services may complicate the management of undescended testes. Local data on surgical outcomes can help identify children who may require closer follow-up and support improvements in referral and operative care.

This study evaluated the rate and types of primary orchiopexy failure and examined patient and operative factors associated with failure among children treated at Kiambu Level 5 Hospital, Kenya.

2. Methods

2.1. Study Design and Setting

We conducted a retrospective cohort study at Kiambu Level 5 Hospital, a county referral hospital in Kiambu County, Kenya. The study period was January 2018 to December 2022 (5 years).

2.2. Study Population

We included all children aged <18 years who underwent primary orchiopexy for unilateral or bilateral cryptorchidism during the study period. We excluded children with: 1) incomplete medical records (lacking operative notes or follow-up data), 2) previous orchiopexy or inguinal surgery, 3) gender-related disorders or chromosomal abnormalities, 4) concomitant major congenital anomalies affecting the genitourinary system, and 5) less than 3 months of documented follow-up. For children with bilateral involvement, each testis/procedure was considered as a separate observation, with statistical adjustment for clustering as described below.

2.3. Data Collection

We reviewed electronic and paper medical records using a standardized data extraction form. Data collected included:

- **Demographic:** Age at surgery, age at diagnosis, referral source.
- **Clinical:** Laterality (unilateral/bilateral), preoperative testicular position (high inguinal, low inguinal, or intra-abdominal as documented on physical examination or ultrasound), preoperative testicular size (normal/small), associated

inguinal hernia or hydrocele.

- **Surgical:** Surgeon grade (consultant vs. trainee), operative technique (open inguinal vs. laparoscopic vs. scrotal), use of testicular fixation (suturing testis to dartos/scrotal wall vs. no fixation), and intraoperative findings.
- **Follow-up:** Duration of follow-up (months), presence and timing of failure, type of failure (re-ascent, atrophy, repeat orchiopexy), and final testicular position.

A detailed study flow diagram is provided in **Figure 1**. Of 120 eligible records screened, 30 were excluded for incomplete follow-up data, 8 for missing operative details, and 4 for prior inguinal surgery, yielding a final analytic sample of 78 children (90 orchiopexies).

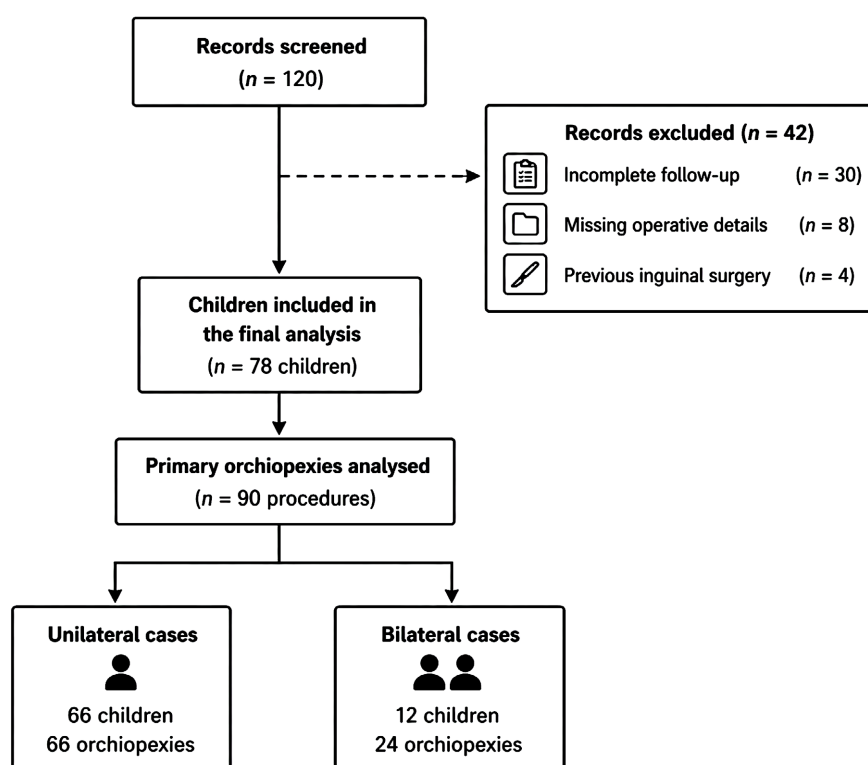


Figure 1. Flow diagram illustrating the selection of study participants. Of 120 medical records screened between January 2018 and December 2022, 42 were excluded (30 with incomplete follow-up, 8 with missing operative details, and 4 with previous inguinal surgery), resulting in 78 eligible children who underwent 90 primary orchiopexies included in the final analysis.

2.4. Outcomes

The primary outcome was orchiopexy failure, defined as the occurrence of any of the following within 12 months of surgery:

- 1) **Re-ascent:** Testis positioned outside the scrotum (high scrotal, penile, or inguinal) on physical examination, confirmed by a pediatric surgeon.
- 2) **Testicular atrophy:** Clinically significant reduction in testicular size compared to the contralateral testis (or previous size) on serial examination, or loss of consistency.

3) Repeat orchiopexy: Any surgical re-intervention for persistent or recurrent cryptorchidism.

Secondary outcomes were the individual components of failure (re-ascent, atrophy, repeat surgery).

2.5. Statistical Analysis

Unit of analysis and clustering: As 90 orchiopexies were performed in 78 children, bilateral cases (12 children) contributed two non-independent observations. Therefore, we analyzed outcomes per testis/per procedure and employed generalized estimating equations (GEE) with an exchangeable correlation structure to account for within-child clustering. All effect estimates and significance tests presented are based on GEE-adjusted analyses.

Descriptive statistics were expressed as frequencies and percentages for categorical variables, and mean (SD) or median (IQR) for continuous variables. Follow-up duration was summarized as median, IQR, and range, with the proportion followed beyond 6 months reported. Differences in baseline characteristics between failure and non-failure groups were compared using GEE-adjusted chi-square or t-tests as appropriate.

Univariable and multivariable GEE logistic regression models were used to identify factors associated with orchiopexy failure. Variables with $p < 0.20$ in univariable analysis were entered into the multivariable model. Effect estimates are reported as odds ratios (OR) with 95% confidence intervals (CI), along with p-values. For the fixation variable, we performed stratified analyses by laterality (unilateral vs. bilateral) and preoperative testicular position (high vs. low) to assess confounding by case complexity, and we present both crude and stratified estimates.

Statistical significance was set at $p < 0.05$ (two-tailed). All analyses were performed using Stata version 17.0 (StataCorp, College Station, TX, USA).

2.6. Ethical Considerations

Ethical approval was obtained from the Mount Kenya University Institutional Ethics Review Committee (Ref: MKU/ISERC/3198).

A waiver of informed consent was granted given the retrospective nature of the study and the use of de-identified data.

3. Results

3.1. Baseline Characteristics

A total of 78 children underwent 90 primary orchiopexies during the 5-year study period. Baseline demographic and clinical characteristics are summarized in **Table 1**.

3.2. Follow-Up Details

All 78 children (100%) were followed for at least 3 months postoperatively. The

median follow-up duration was 8 months (IQR: 5 - 14 months; range: 3 - 48 months). A total of 62 children (79.5%) were followed beyond 6 months. No patients were lost to follow-up within the first 3 months, and all included patients had documented final outcome assessment.

Table 1. Baseline characteristics of children undergoing primary orchiopexy.

Characteristic	Total (N = 78 children, 90 testes)
Age at surgery, years	
Median (IQR)	4.5 (2.5 - 7.0)
Range	0.8 - 14.0
<2 years	15 (19.2%)
2 - 5 years	32 (41.0%)
>5 years	31 (39.8%)
Laterality	
Unilateral	66 (84.6%)
Bilateral	12 (15.4%)
Preoperative testicular position	
High inguinal	38 (42.2%)
Low inguinal	42 (46.7%)
Intra-abdominal	10 (11.1%)
Preoperative testicular size	
Normal	62 (68.9%)
Small	28 (31.1%)
Associated hernia/hydrocele	
	18 (23.1%)
Surgeon grade	
Consultant	54 (69.2%)
Trainee (with supervision)	24 (30.8%)
Operative technique	
Open inguinal	76 (84.4%)
Laparoscopic	10 (11.1%)
Scrotal (primary)	4 (4.5%)
Testicular fixation used	
	52 (57.8%)

3.3. Orchiopexy Failure Rate and Components

Overall, orchiopexy failure occurred in 12 of 90 procedures (13.3%). The breakdown of failure types was as follows:

- **Re-ascent:** 7/12 (58.3%);

- **Testicular atrophy:** 3/12 (25.0%);
- **Repeat orchiopexy:** 2/12 (16.7%).

All repeat orchiopexies were performed for re-ascent that was not amenable to conservative management. The median time to failure detection was 4 months (IQR: 3 - 7 months) for re-ascent and 6 months (IQR: 5 - 9 months) for atrophy.

3.4. Factors Associated with Orchiopexy Failure

Table 2 presents the GEE-adjusted univariable and multivariable analyses of factors associated with orchiopexy failure.

Table 2. Factors associated with primary orchiopexy failure (GEE-Adjusted).

Variable	Failure (N = 12)	No Failure (N = 78)	Univariable OR (95% CI)	p-value	Multivariable OR (95% CI)	p-value
Age at surgery (per year increase)	-	-	1.08 (0.95 - 1.23)	0.24	-	-
Laterality						
Unilateral (ref)	7 (58.3%)	65 (83.3%)	1.0	-	1.0	-
Bilateral	5 (41.7%)	13 (16.7%)	2.3 (1.2 - 4.5)	0.015	2.1 (1.1 - 4.0)	0.032
Preoperative position						
Low inguinal (ref)	2 (16.7%)	40 (51.3%)	1.0	-	1.0	-
High inguinal	6 (50.0%)	32 (41.0%)	3.1 (1.4 - 6.8)	0.005	2.9 (1.3 - 6.5)	0.008
Intra-abdominal	4 (33.3%)	6 (7.7%)	4.8 (2.0 - 11.5)	0.001	4.1 (1.7 - 9.9)	0.002
Testicular size (small vs. normal)	6 (50.0%)	22 (28.2%)	2.2 (0.9 - 5.2)	0.08	2.0 (0.8 - 5.0)	0.12
Surgeon grade (trainee vs. consultant)	5 (41.7%)	19 (24.4%)	1.6 (0.7 - 3.9)	0.28	-	-
Fixation used (yes vs. no)	5 (41.7%)	47 (60.3%)	0.6 (0.3 - 1.2)	0.12	<i>See stratified analysis below</i>	

Note: All models adjusted for within-child clustering using GEE. Variables with $p < 0.20$ in univariable analysis were included in the multivariable model.

Independent predictors of failure on multivariable analysis:

- **Bilateral cryptorchidism:** OR = 2.1; 95% CI: 1.1 - 4.0; $p = 0.032$.
- **High inguinal position:** OR = 2.9; 95% CI: 1.3 - 6.5; $p = 0.008$.
- **Intra-abdominal position:** OR = 4.1; 95% CI: 1.7 - 9.9; $p = 0.002$.

Stratified analysis of fixation effect: The apparent protective effect of fixation (OR = 0.6) was confounded by case complexity. In a stratified analysis:

- **Among unilateral cases (66 procedures):** Fixation was used in 35/66 (53.0%); failure occurred in 5/35 (14.3%) with fixation vs. 2/31 (6.5%) without ($p = 0.32$).
- **Among bilateral cases (24 procedures):** Fixation was used in 17/24 (70.8%); failure occurred in 4/17 (23.5%) with fixation vs. 1/7 (14.3%) without ($p = 0.61$).
- **Among high/inguinal/intra-abdominal cases (48 procedures):** Fixation was used in 32/48 (66.7%); failure occurred in 6/32 (18.8%) with fixation vs. 2/16 (12.5%) without ($p = 0.58$).

These findings indicate that fixation was preferentially performed in more complex cases, and when adjusted for complexity through stratification, no independent protective effect was observed.

4. Discussion

In this retrospective cohort study of 90 primary orchiopexies performed at a Kenyan tertiary hospital, we found an overall failure rate of 13.3%, with re-ascent accounting for the majority of failures (58.3%). Bilateral cryptorchidism and high preoperative testicular position were independent predictors of failure. The fixation of the testis did not demonstrate a clear protective effect after accounting for confounding by case complexity.

4.1. Failure Rate in Context

The observed failure rate was 13.3%. Published surgical series and reviews report variable outcomes, and comparisons depend on case mix, testicular position, operative technique, follow-up duration, and the definition of failure [7]-[9].

4.2. Predominance of Re-Ascent

Re-ascent was the most common failure mechanism in our cohort (58.3%). Re-ascent is a recognized adverse outcome after orchiopexy, and adequate mobilization, a tension-free dependent scrotal position, and appropriate management of the processus vaginalis are important technical considerations [4] [7] [8]. The proportion of failures attributable to re-ascent varies across studies and definitions.

4.3. Testicular Atrophy

Atrophy occurred in 3/90 (3.3%) of procedures. Testicular atrophy is a recognized complication of orchiopexy, with risk influenced by testicular position and the complexity of dissection; the rate varies across patient populations and operative approaches [7]-[9]. In our cohort, all three atrophy cases involved high inguinal ($n = 1$) or intra-abdominal ($n = 2$) testes, and two were in bilateral cases. This supports careful vascular preservation and appropriate planning for high-risk testes [4] [8] [9].

4.4. Predictors of Failure

Bilateral cryptorchidism was an independent predictor of failure in our cohort ($OR = 2.1$; 95% CI: 1.1 - 4.0). Bilateral UDT may be associated with more complex underlying testicular development and fertility considerations; the present study's association should be interpreted in the context of its sample size and design [4].

High preoperative testicular position was the strongest predictor in our cohort, with intra-abdominal testes having fourfold higher odds of failure than low inguinal testes. This is clinically plausible because high testes often require more extensive dissection and specialized operative approaches [4] [7]-[9].

4.5. The Role of Fixation—A Nuanced Interpretation

In our unadjusted analysis, fixation appeared to reduce failure risk (OR = 0.6; 95% CI: 0.3 - 1.2), although this did not reach statistical significance. However, when we stratified by laterality and preoperative position, the protective effect was not observed; in fact, fixation was more commonly used in complex cases, reflecting a “confounding by indication” scenario. This is a critical insight: surgeons are more likely to fixate testes that are at higher risk of re-ascent, making direct comparison misleading.

The operative priority remains achieving a stable, dependent, tension-free scrotal position while preserving the testicular vascular supply [4] [7] [8]. Our findings suggest that fixation may have been a marker of surgical concern rather than an independent predictor of success; this interpretation requires cautious consideration because of the retrospective design and limited sample size.

4.6. Delayed Presentation—A Persistent Challenge

The median age at surgery in our cohort was 4.5 years, later than the age recommended in contemporary guidance, which supports referral during infancy and orchiopexy within the recommended early-childhood period [4] [5]. This finding highlights an opportunity to strengthen early detection and referral pathways.

4.7. Strengths and Limitations

Strengths of this study include: 1) the use of GEE analysis to appropriately handle within-child clustering in bilateral cases, ensuring valid statistical inference; 2) a detailed breakdown of failure components, which clarifies the mechanism driving overall failure; 3) the inclusion of 95% confidence intervals for effect estimates, providing a measure of precision; 4) stratified analysis of fixation, which addresses confounding by indication; and 5) the provision of a complete flow diagram and detailed follow-up metrics to allow assessment of selection bias and outcome detection.

Limitations include: 1) the retrospective design, which limits the ability to capture all potential confounders (e.g., intraoperative tension, cord length, surgeon experience-related technical nuances); 2) the single-center setting, which may limit generalizability to other Kenyan or African hospitals with different resources and case mix; 3) a relatively small sample size, especially in the bilateral and intra-abdominal subgroups, which may have reduced power for detecting some associations; 4) incomplete records in some cases, though we attempted to mitigate this through strict exclusion criteria; and 5) the lack of long-term outcomes (e.g., fertility, malignancy) beyond the 12-month postoperative period.

4.8. Implications for Practice and Policy

Our findings have several practical implications:

- **For surgeons:** High inguinal and intra-abdominal testes, especially in bilateral cases, should be recognized as high-risk and may benefit from laparoscopic or staged procedures. Careful mobilization to achieve a tension-free, dependent scrotal position should be prioritized over routine fixation.
- **For training programs:** Surgical trainees should receive structured mentoring in high-risk orchiopexy, with emphasis on vascular preservation and cord-lengthening techniques.
- **For health systems:** Interventions to reduce delayed presentation—such as community education, training of primary care workers in newborn genital examination, and streamlined referral pathways—are essential to improve both surgical success and long-term outcomes.
- **For policy:** Considering that delayed orchiopexy has implications for fertility and malignancy, integrating cryptorchidism screening into maternal and child health programs and ensuring affordable surgical care could reduce the burden of complications.

4.9. Future Research

Prospective multicenter studies with standardized intraoperative measurements, longer follow-up, and assessment of patient-reported outcomes are needed. Additionally, cost-effectiveness analyses of laparoscopic versus open orchiopexy in LMIC settings, and implementation research on early detection strategies, would be valuable.

5. Conclusion

Primary orchiopexy failure occurs in over 13% of procedures at our Kenyan tertiary hospital, with re-ascent being the dominant mechanism. Bilateral cryptorchidism and high preoperative testicular position are independent predictors of failure. The use of testicular fixation appears confounded by case complexity and does not show a clear protective effect in stratified analysis. Delayed presentation remains a major modifiable challenge. Strategies to promote early referral, improve surgical techniques for complex cases, and enhance training are critical to reducing failure rates and improving long-term outcomes for children with cryptorchidism in resource-limited settings.

Author Contributions

Joseph Musamia Tabalya conceived and designed the study, coordinated data collection, participated in data analysis and interpretation, and drafted the manuscript. Shreya Gyanesh Srivastava contributed to study design, data interpretation, critical revision of the manuscript, and approval of the final version. Both authors reviewed and approved the final manuscript.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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