Clinical Research

Comparing suturing techniques and materials in hypospadias repair: a prospective cohort study

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ABSTRACT

BACKGROUND Various techniques are available for hypospadias surgery, but the most effective suturing techniques and suture materials remain debated. This study aimed to evaluate the outcomes of hypospadias repair using various suturing techniques and materials.

METHODS This prospective cohort study was conducted from August 2023 to August 2024 and included all patients who underwent hypospadias surgery at Cipto Mangunkusumo Hospital. We compared the outcomes of 2 suturing techniques (interrupted *versus* continuous) and 2 suture materials (6-0 polydioxanone [PDS] *versus* poliglecaprone 25) used for neourethra suturing. Follow-up assessments were conducted at 1, 2, and 4 weeks postoperatively, and subsequently every 3 to 6 months, focusing on complications.

RESULTS 162 participants were included, with a mean age of 6.27 (3.99) years and a mean follow-up period of 20.39 (14.25) weeks. Complications occurred in 31 patients (19.1%), with a significant association between hypospadias type and complication occurrence (p = 0.039). Complication rates were 9.4% in distal, 12.5% in midshaft, and 26.8% in proximal cases. No significant differences were found between suturing techniques (interrupted: 19% *versus* continuous: 12%, p = 0.429) or suture materials (6-0 PDS: 22% *versus* 6-0 poliglecaprone 25: 9%, p = 0.998). Subgroup analyses by hypospadias type also showed no significant differences by suture type or technique (all p>0.05), although a trend toward significance was noted in proximal cases (p = 0.062).

CONCLUSIONS The choice of suturing techniques and suture materials does not affect complication rates in hypospadias repair, allowing surgeons to decide based on personal expertise and preference.

KEYWORDS hypospadias, sutures, suture techniques, urinary fistula, wound dehiscence

Hypospadias is a congenital condition characterized by the urethral opening being located on the ventral surface of the penis rather than at its tip. The position of the urethral meatus can vary along the ventral aspect; in severe cases, the urethral meatus is located close to the scrotum.[1] Evaluation of hypospadias includes a thorough medical history and physical examination, which often reveals dysplastic ventral tissue and absent skin along the ventral penile axis.[1] Hypospadias can impair both urination and sexual function, often resulting in a misdirected urine stream that may cause spraying or downward flow depending on the severity of misalignment.[2] Additionally, hypospadias may lead to chordee, a penile curvature that can negatively impact both function and appearance, including future sexual activity.[1,3]

Recent advancements in hypospadias management highlight the importance of early intervention and surgical correction to avoid long-term complications

and preserve optimal urinary and sexual functions. Surgical intervention aims to correct penile curvature and reposition the external urethral meatus to its anatomically appropriate location.[4] Various surgical procedures can be employed, including tissue grafting or the use of pre-existing tissue, depending on the individual case.

Despite advancements in hypospadias repair, complications remain common.[1,3] One of the most common complications is urethrocutaneous fistula,[4] an abnormal connection between the urethra and skin. It often necessitates follow-up surgery and is typically detected within the first year after the initial procedure, although it may also present years later.[5] Urethrocutaneous fistula usually manifests as urine leakage through the skin and is often associated with urinary incontinence, erythema, or localized infections. Detection of complications involves imaging techniques, including contrast-enhanced radiography to visualize urine flow and endoscopy for direct examination of the urethra and bladder. Endoscopy is also used for fistula mapping to assess its shape, depth, and orientation.[6] Other less common complications include urethral stenosis and wound dehiscence.[4] Wound dehiscence following hypospadias surgery may involve separating glandular or prepuce tissue. Diagnosis typically involves a detailed medical history and physical examination, revealing findings such as wound edge separation, edema, discomfort, or exposure of underlying tissue.[7]

Complications after hypospadias repair reportedly occur in 5–10% of mild cases and 15–65% of severe cases.[1,4] While absorbable sutures are widely used, variations in suturing techniques and materials have contributed to these inconsistent complication rates. Previous studies have been limited by retrospective designs or single-center data, resulting in a significant gap in comparative data.[8,9] Moreover, few studies have systematically compared various suturing techniques and materials used in hypospadias repair. Addressing this knowledge gap is essential for improving surgical efficiency and enhancing patient outcomes.

This prospective cohort study represents the first large-scale comparison of suturing techniques and materials used in pediatric hypospadias repair. This study aimed to clarify the relationship between suture material, suturing technique, hypospadias repair outcomes, and postoperative complications. The null hypothesis posits no significant differences among the techniques. By addressing this gap, the present study provides insights into how different suturing methods influence complication rates and surgical efficiency, thereby supporting evidence-based surgical decision-making.

METHODS

This prospective cohort study was conducted in a single center of Cipto Mangunkusumo Hospital from August 2023 to August 2024. The study included all cases of primary hypospadias and second-stage repairs regardless of meatal location or chordee severity, with follow-up for each participant lasting 6 months. The exclusion criteria were recurrent hypospadias, first-stage repairs, and significant residual curvature requiring urethral plate division. Participants were recruited from a urology clinic through simple random sampling with an expected 10% difference in complication rates between groups (alpha level = 0.05, power = 80%) with the minimum size of 150 patients. Written consent was obtained from all participants prior to surgery, and the study was approved by the Ethics Committee of the Faculty of Medicine, Universitas Indonesia – Cipto Mangunkusumo Hospital (No: KET-166/UN2.F1/ETIK/PPM.00.02/2024).

Hypospadias was classified according to the location of the external urethral meatus. All surgeries were performed using magnification loops by three experienced pediatric urology surgeons, each with at least 5 years of surgical experience. All patients underwent penile degloving followed by excision of the inelastic, dark ventral tissue to correct the chordee. Minimal residual curvature was corrected using dorsal plication methods, including the Baskin or Nesbit techniques. Following chordee correction, the hypospadias repair technique was selected based on meatal location, characteristics of the urethral plate and glans, and the individual surgeon's preference. The surgical procedures included tubularized incised plate (TIP), Thiersch-Duplay, Mathieu, and onlay island flap techniques.

We compared suturing techniques (interrupted *versus* continuous) and suture materials (6-0 polydioxanone [PDS] *versus* poliglecaprone 25) used for neourethral reconstruction to evaluate their potential impact on surgical outcomes, such as complication rates. The choice of technique and material was based on individual surgeon preference.

All patients received a second-layer coverage using either a Dartos or tunica vaginalis flap. Postoperatively, a silastic stent was removed between postoperative Days 5 and 7, and urinary diversion via percutaneous cystostomy was maintained for approximately 2 weeks in all patients. Compressive dressings were applied immediately after surgery. Follow-up assessments were conducted at 1, 2, and 4 weeks postoperatively, and subsequently every 3–6 months at the urology polyclinic during the consultation session. Evaluations included postoperative complications, urethral meatus shape and quality, and urinary function, including voiding time.

The primary outcome was the overall complication rate, while secondary outcomes included the incidence of urethrocutaneous fistula and wound dehiscence. A urethrocutaneous fistula was defined as an abnormal connection between the urethra and skin, identified through anamnesis and physical examination. Wound dehiscence was defined as partial or complete separation of wound edges observed during clinical assessment. Both complications were evaluated through standardized procedures conducted at each follow-up visit.

Categorical data are presented as percentages and continuous data as means with standard deviations. Chi-square and independent *t*-tests were used to assess associations between several variables and postoperative complications. Subgroup analyses were conducted for each complication type (urethrocutaneous fistula or wound dehiscence) and hypospadias type (proximal, midshaft, and distal) to assess the impact of different suturing techniques and materials. Statistical significance was set at $p<0.05$. Statistical analysis was performed using the SPSS software version 25.0 (IBM Corp., USA).

RESULTS

A total of 162 participants were included in the study, with no loss to follow-up. The mean age of participants was 6.27 (3.99) years, with a mean follow-up duration of 20.39 (14.25) weeks. The most prevalent type was the proximal hypospadias observed in 50.6% of patients. Among the patients, 115 (71.0%) received 6-0 PDS, whereas 47 (29.0%) received 6-0 poliglecaprone 25. Continuous suturing was applied in 53 patients (32.7%), whereas 109 patients (67.3%) received interrupted suturing. The most commonly used second-stage repair technique was the Thiersch-Duplay procedure (35.2%) (Table 1).

The overall complication rate was 19.1%, with urethrocutaneous fistulas and wound dehiscence occurring in 11.7% and 7.4% of cases, respectively. A statistically significant association was found between hypospadias type and complication rates ($p = 0.039$) (Table 1); however, no significant differences were observed based on suturing technique ($p = 0.429$) or material ($p = 0.998$) (Table 2). Additionally, stratified analysis by hypospadias type revealed no significant differences in complication rates between suture materials or techniques (Table 3).

Table 1. Factors affecting complication of hypospadias repair

	Complications		
Variables	Present (N = 31)	Absent (N = 131)	*p*
Age (years), mean (SD)	6.29 (3.77)	6.24 (4.06)	0.947
BMI, mean (SD)	18.84 (5.86)	17.33 (4.66)	0.313
Hypospadias types, n (%)			**0.039**
Distal	3 (9.4)	29 (90.6)	
Midshaft	6 (12.5)	42 (87.5)	
Proximal	22 (26.8)	60 (73.2)	
Hypospadias repair, n (%)			0.608
TIP	7 (18.4)	31 (81.6)	
Thiersch-Duplay (second-stage repair)	13 (22.8)	44 (77.2)	
Onlay island flap	8 (14.3)	48 (85.7)	
Mathieu procedure	3 (27.3)	8 (72.7)	

BMI=body mass index; SD=standard deviation; TIP=tubularized incised plate

Table 2. Analysis of complication between different suture materials and suturing techniques

Complications	Suture materials			Suturing techniques		
	6-0 PDS, n (%) (N = 115)	6-0 poliglecaprone 25, n (%) (N = 47)	*p*	Interrupted suture, n (%) (N = 109)	Continuous suture, n (%) (N = 53)	*p*
Urethrocutaneous fistula	12 (10.4)	7 (14.9)	0.423	11 (10.1)	8 (15.1)	0.353
Wound dehiscence	10 (8.7)	2 (4.3)	0.327	8 (7.3)	4 (7.5)	0.962
Total complication	22 (19.1)	9 (19.1)	0.998	19 (17.4)	12 (22.6)	0.429

PDS=polydioxanone

Table 3. Subanalysis of complication between different suture materials and suturing techniques in different hypospadias types

Hypospadias types	Suture materials			Suturing techniques		
	6-0 PDS, n (%)	6-0 poliglecaprone 25, n (%)	*p*	Interrupted suture, n (%)	Continuous suture, n (%)	*p*
Distal			1.000			1.000
Complication (n = 3)	2 (10)	1 (9)		1 (7)	2 (12)	
Urethrocutaneous fistula	1 (5)	1 (9)		1 (7)	1 (6)	
Wound dehiscence	1 (5)	0 (0)		0 (0)	1 (6)	
No complication (n = 29)	19 (90)	10 (91)		14 (93)	15 (88)	
Midshaft			0.656			1.000
Complication (n = 6)	5 (15)	1 (7)		4 (14)	2 (11)	
Urethrocutaneous fistula	3 (8)	1 (7)		3 (10)	1 (5.5)	
Wound dehiscence	2 (7)	0 (0)		1 (4)	1 (5.5)	
No complication (n = 42)	29 (85)	13 (93)		25 (86)	17 (89)	
Proximal			0.580			0.062
Complication (n = 22)	15 (25)	7 (32)		14 (22)	8 (47)	
Urethrocutaneous fistula	8 (13)	5 (23)		7 (13)	6 (35)	
Wound dehiscence	7 (12)	2 (9)		7 (13)	2 (12)	
No complication (n = 60)	45 (75)	15 (68)		51 (78)	9 (53)	

PDS=polydioxanone

DISCUSSION

Surgical interventions remain the primary treatment for hypospadias, demonstrating high overall satisfaction rates in cosmetic, sexual, and functional outcomes.[8–10] In the present study, the overall complication rate was 19.1%, which falls on the lower end of the reported complication range.[1,4] Notably, our findings suggest that neither suture material nor suturing technique significantly impacts the overall complication rate in hypospadias repair. Furthermore, complications in this study were most frequently observed in proximal hypospadias cases, consistent with prior studies that report higher complication rates in complex cases such as proximal hypospadias.[11,12]

Hypospadias repair involves using various suturing techniques and materials, most commonly absorbable monofilament sutures. This study found no significant difference in complication rates between 6-0 PDS and 6-0 poliglecaprone 25, despite suture material being considered an important factor in minimizing complications following hypospadias repair. Ulman et al[13] reported fewer complications with PDS compared to polyglactin sutures, and Shirazi et al[9] reported similar findings when comparing PDS with polyglactin 910 sutures. Although other studies have shown that 6-0 PDS is associated with lower complication rates than braided multifilament sutures, the present study found no significant difference in complication rates when comparing 6-0 PDS and poliglecaprone 25.

The suturing technique contributes to the success of hypospadias surgery; however, no consensus has been reached regarding the optimal method. Although interrupted sutures may prolong operative time, they are theoretically associated with a reduced risk of tissue entrapment compared with continuous sutures.[14] This study found no significant difference in complication rates between interrupted and continuous suturing techniques. Similarly, a randomized controlled trial (RCT) by Gupta et al[8] reported no significant differences in overall complication and urethrocutaneous fistula rates between the interrupted and continuous suture groups. However, Samir et al[14] reported significantly higher complication and urethrocutaneous fistula rates with continuous sutures in TIP repairs, despite a shorter operative time. Sarhan et al[15] also observed higher reoperation rates in patients who received continuous sutures compared to those with interrupted sutures. Differences between prior studies and the present study may be attributable to the surgical techniques used, as earlier research primarily focused on TIP repairs, whereas this study included various types of hypospadias repairs.

Borkar et al[16] assessed the success and complication rates associated with different suturing techniques in patients undergoing Snodgrass urethroplasty for primary hypospadias. They reported no significant differences in overall complication or urethrocutaneous fistula rates between the groups.[16] Similarly, a meta-analysis focusing on TIP procedures found no significant differences in complication rates between interrupted and continuous suturing techniques.[17] These findings are consistent with our findings, suggesting that neither suture material nor suturing technique significantly affects complication rates in hypospadias repair. However, another study reported higher complication rates in TIP procedures using continuous subcuticular sutures, particularly for cutaneous fistulas, although wound separation rates remained similar.[14] Clinically, these observations suggest that surgeons may select suturing techniques and materials based on surgical efficiency, cost considerations, or personal expertise, rather than anticipated complication rates. This evidence supports a flexible, individualized approach to suturing technique and material selection in hypospadias repair.

This study has some limitations. Conducting the study at referral hospitals in Jakarta may have introduced selection bias and limited the generalizability of the findings. Additionally, the predominance of proximal hypospadias cases may reflect referral patterns, potentially affecting the distribution and representation of different hypospadias types. As an observational study, variability in surgical techniques across different surgeons may have introduced bias into the results. Multivariate analyses were not performed, which limited the ability to control for potential confounding factors. The absence of standardized hypospadias repair protocols may have influenced outcome comparisons between suturing techniques and materials. However, all participating surgeons had comparable levels of experience, and the study clearly defined inclusion and exclusion criteria.

In conclusion, suturing techniques and materials did not significantly influence the occurrence of complications following hypospadia repair. Therefore, surgeons may choose suturing techniques and materials based on individual expertise, efficiency, and preference. Future well-designed RCTs are needed to further investigate the association between various suturing techniques and suture materials and the occurrence of complications following hypospadias repair.

Conflict of Interest

The authors affirm no conflict of interest in this study.

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