

HYPOSPADIA REPAIR SURGERY LEARNING CURVE IN PEDIATRIC UROLOGY FELLOWSHIP PROGRAM

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ABSTRACT

Introduction: The paediatric urology fellowship program was designed to accelerate the learning curve of junior urologist in various paediatric urology procedures, including hypospadias repair. **Objective:** This study aimed to provide insight in the learning curve of hypospadias repair during the paediatric urology fellowship program. **Material & Methods:** Three paediatric urology fellows performed 176 hypospadias repairs at four Jakarta, Indonesia, centers throughout their six-month fellowship training program between January 2022 and January 2023. Secondary repair or the initial stage of staged repair were excluded from the analysis. Complications such as urethrocutaneous fistula formation and wound dehiscence requiring secondary repair were documented. The learning curve of each fellow in hypospadias repair was documented. **Results:** Each fellow performed a median of 58 procedures (range: 56–62) during their training period. A total of 34 (19.3%) experienced complications, including 19 cases of fistula formation and 15 cases of wound dehiscence, over a mean follow-up period of 24.1 ± 17.1 weeks. There were no significant differences in demographics, distribution of hypospadias, or complication rates observed among the fellows. Notably, there was a significant improvement in the learning curve for each fellow after performing 30 consecutive cases, achieving a success rate of over 84%. The average success rate showed a significant increase from 74.4% to 87.2% after 30 cases ($p=0.032$). **Conclusion:** Significant improvement of hypospadias repair success rate was observed among paediatric urology fellows after performing 30 consecutive hypospadias repair during their training. This improvement suggests that the fellowship program likely played a pivotal role in accelerating their learning curve.

Keywords: Fellowship, hypospadias, learning curve, urethrocutaneous.

ABSTRAK

Pendahuluan: Program fellowship urologi pediatrik dirancang untuk mempercepat kurva pembelajaran ahli urologi junior dalam berbagai prosedur urologi pediatrik, termasuk perbaikan hipospadia. **Tujuan:** Penelitian ini bertujuan untuk memberikan wawasan mengenai kurva pembelajaran prosedur perbaikan hipospadia selama program fellowship urologi pediatrik. **Bahan & Cara:** Tiga dokter fellow urologi pediatrik melakukan 176 prosedur perbaikan hipospadia di empat pusat layanan kesehatan di Jakarta, Indonesia, selama program pelatihan fellowship enam bulan antara Januari 2022 dan Januari 2023. Prosedur perbaikan sekunder atau tahap awal dari perbaikan bertahap tidak disertakan dalam analisis. Komplikasi seperti pembentukan fistula uretrokutan dan dehisensi luka yang memerlukan perbaikan sekunder turut didokumentasikan. Kurva pembelajaran setiap dokter fellow dalam prosedur perbaikan hipospadia juga dicatat. **Hasil:** Setiap fellow melakukan median 58 prosedur (rentang: 56–62) selama masa pelatihan mereka. Sebanyak 34 orang (19,3%) mengalami komplikasi termasuk 19 kasus pembentukan fistula dan 15 kasus dehisensi luka selama masa pemantauan rata-rata $24,1 \pm 17,1$ minggu. Tidak ditemukan perbedaan signifikan dalam hal demografi, distribusi hipospadia, maupun tingkat komplikasi di antara para fellow tersebut. Yang patut dicatat, terdapat peningkatan signifikan pada kurva pembelajaran setiap fellow setelah menangani 30 kasus berturut-turut, dengan pencapaian tingkat keberhasilan di atas 84%. Rata-rata tingkat keberhasilan menunjukkan peningkatan signifikan dari 74,4% menjadi 87,2% setelah 30 kasus ($p=0,032$). **Simpulan:** Peningkatan signifikan dalam tingkat keberhasilan operasi perbaikan hipospadia diamati pada dokter fellow urologi pediatrik setelah mereka melakukan 30 prosedur perbaikan hipospadia secara berturut-turut selama masa pelatihan. Peningkatan ini mengindikasikan bahwa program fellowship kemungkinan besar berperan penting dalam mempercepat kurva pembelajaran mereka.

Kata kunci: Fellowship, hipospadia, kurva pembelajaran, uretrokutan.

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INTRODUCTION

Hypospadias is one of the most common congenital anomalies in pediatric cases, with varying total prevalence worldwide. In Europe, prevalence of hypospadias is around 18.6 new cases per 10,000 births.¹ While in Indonesia, prevalence of hypospadias is widely distributed. In 2017, around 591 cases of hypospadias were documented across 12 healthcare centers, with a consistent annual increase.² Hypospadias can be classified based on the anatomical location of the displaced urethral orifice (proximal, midshaft and distal). This classification serves as a reference for further management decisions.¹

Numerous surgical techniques for the correction of hypospadias have been documented, reflecting the condition's varying degrees of severity and classification. Advancements in surgical techniques have led to improved cosmetic and functional outcomes for hypospadias. This has resulted in shorter hospital stays, the ability to operate on younger patients and more complex cases, and a reduced rate of complications.³ As time advances, the demand for surgeon proficiency also rises.

Enhancing surgical experience is a crucial aspect in improving surgeon skill, particularly in addressing hypospadias cases, this aspect can be interpreted as learning curve in managing hypospadias cases. Paediatric urology fellowship program was designed to accelerate the learning curve of junior urologist in various paediatric urology procedures, including hypospadias repair.

OBJECTIVE

This study aimed to provide insight in the learning curve of hypospadias repair during the paediatric urology fellowship program.

MATERIAL & METHODS

A total of 176 hypospadias repairs were conducted by three paediatric urology fellows throughout their six-months fellowship training program from January 2022 to January 2023 at four paediatric urology centers in Jakarta, Indonesia. The analysis did not include patients who underwent secondary repair or the initial stage of staged repair.

We evaluated the patients' age, body mass index (BMI), type of hypospadias, and occurrence of

complications at the time of surgery. The classification of hypospadias was determined by observing the location of the meatus after the removal of the skin and correction of the downward curvature. Instances of complications, such as the formation of urethrocutaneous fistula and wound dehiscence that need further repair, were documented. Fistula was defined as abnormal connection between a segment of the urethra and the skin, causing urine to come out of a separate opening, while wound dehiscence was defined as a partial or total separation of previously approximated wound edges, due to a failure of proper wound healing. Follow-up visits were conducted after the repairs to detect and find any complications. The learning curve of each fellow in hypospadias repair was documented.

We evaluate the impact of the surgeon's proficiency on the occurrence of complications by comparing the rates of success in groups of 15 consecutive cases. The success rate of Hypospadias repair was assessed by computing the difference of cases without complications to the total number of cases treated by the surgeon within a specific timeframe. All analyses were conducted using Microsoft Excel 2016 and IBM SPSS Statistics version 26.

RESULTS

The study consisted of a group of 176 participants. The median age of the patients for Fellow A, B, and C was 7 years (range: 1-15), 6 years (range: 1-12), and 4 years (range: 2-15), respectively. The median body mass index (BMI) of the patients for Fellow A, B, and C was 16.98 (range: 11.34 – 34.63), 15.36 (range: 11.75 – 30.88), and 15.73 (range: 11.73 – 30.22), respectively. There was no statistically significant difference in the age and BMI of the patient who was treated by 3 fellows ($p = 0.132$ for age and $p = 0.373$ for BMI).

Each fellow performed a median of 58 procedures (range: 56–62) during their training period, with the majority of surgeries involving proximal hypospadias cases (>50%). Primary repair was performed in 40 distal cases (15, 15 and 10 cases from fellow A, B and C respectively), 34 midshaft case (15, 11 and 8 cases), and 102 proximal hypospadias cases (32, 32 and 108 cases). Of the 176 surgical procedures, second-stage repairs (involving tubularization or the Thiersch-Duplay technique) for proximal hypospadias were the highest procedure

done with a total of 105 (59.65%) cases, while 71 (40.34%) were single-stage procedures. These single-stage surgeries included 15 tubularized incised plate procedures, 47 dorsal preputial island flap repairs, and 9 Mathieu procedures for distal and midshaft hypospadias.

Among the total amount of cases, 34 patients (19.3%) experienced complications during an average follow-up time of 24.1 ± 17.1 weeks. These complications consisted of 19 cases of fistula formation and 15 cases of wound dehiscence. There was no statistically significant variation in postoperative complications among all the fellows (19.3% in fellow A, 20.68% in fellow B, and 17.8% in fellow C). Fellow A experienced a total of 12 complications, with seven cases (11.3%) of fistula and five cases (8.1%) of wound dehiscence. Fellow B encountered a total of 12 instances of complications, consisting of 6 cases (10.3%) of fistula and 6 cases (10.3%) of wound dehiscence. On the other hand, Fellow C experienced a total of 10 instances of complications, with 6 (10.7%) of them being fistulas and 4 (7.1%) occurrences being wound dehiscence.

Of the total complications, 14 occurred in proximal hypospadias (second-stage repair), 10 in mid-hypospadias (with operations including two

second-stage repairs and eight dorsal onlays), and 10 in distal hypospadias (including six dorsal onlays, two TIPs, and two Mathieu cases). The highest complication rate was found in second-stage repair, where the level of complexity was generally higher.

Regarding the complications, it was seen that the majority of them occurred in the initial 30 cases. However, there was significant improvement in the last 30 cases, with fellow A, B, and C experiencing 4, 4, and 3 cases, respectively. The complication rates did not differ significantly between each fellow, with p-values of 0.986 for fistula complications and 0.819 for wound dehiscence issues. The majority of complications were treated with primary closure and repair.

The analysis of 15 cases by each fellow shown a decrease in the rate of complications over time, corresponding to the surgeon's increasing expertise. In addition, the diagram depicting the cumulative success rate of hypospadias repair demonstrated a relative plateau after 45 cases. It is worth mentioning that there was a significant improvement in the learning curve of hypospadias repair for each fellow after performing 30 consecutive cases, achieving a success rate of over 84% (Figure 1). The mean success rate demonstrated a substantial improvement from 74.4% to 87.2% following the completion of 30 instances ($p=0.032$).

Table 1. The demographics, distribution of hypospadias, and complication rate between each fellow during their training.

	Total	Fellow A (N = 62)	Fellow B (N = 58)	Fellow C (N = 56)	P value
Age (years)	6 (1-15)	7 (1-15)	6 (1-12)	4 (2-15)	0.132
BMI (kg/m ²)	16 (11.34 - 34.63)	16.98 (11.34 – 34.63)	15.36 (11.75 – 30.88)	15.73 (11.73 – 30.22)	0.373
Hypospadias type					0.427
Distal		15 (24.2%)	15 (25.9%)	10 (17.9%)	
Mid-shaft		15 (24.2%)	11 (19.0%)	8 (14.3%)	
Proximal		32 (51.6%)	32 (55.2%)	38 (67.9%)	
Urethroplasty technique					0.531
TIP		5 (8.1%)	8 (13.8%)	2 (3.6%)	
Mathieu procedure		3 (4.8%)	3 (5.2%)	3 (5.4%)	
Dorsal preputial island flap		19 (30.6%)	15 (25.9%)	13 (23.2%)	
2 nd stage of staged procedure		35 (56.5%)	32 (55.2%)	38 (67.9%)	
Complication		12 (19.4%)	12 (20.7%)	10 (17.9%)	0.929
Fistula		7 (11.3%)	6 (10.3%)	6 (10.7%)	0.986
Wound dehiscence		5 (8.1%)	6 (10.3%)	4 (7.1%)	0.819

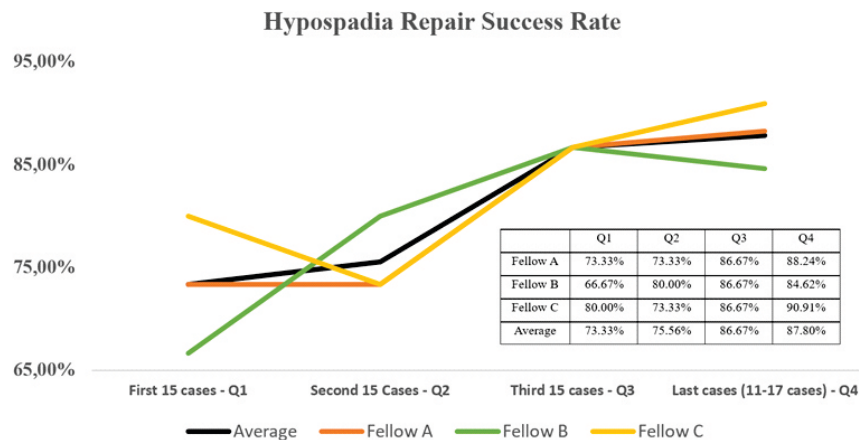


Figure 1. Hypospadias repair success rate of each fellow based on number of consecutive cases during their training.

DISCUSSION

A learning curve is a graphical representation that illustrates the correlation between the level of exertion, such as practice repetition or time allocation, and the degree of learning attained through certain achievements.⁴ The concept of learning curves is based on the principle that additional practice enhances performance, and "adequate practice results in higher levels of achievement". The examination of individual learning curves offers valuable information into the educational advancement of a specific individual. They can aid in the detection of individuals who have successfully attained specified learning goals or those who may necessitate further education or further support. Plateaus on learning curves indicate the stage at which the likelihood of achieving more enhancements in performance within a specific situation becomes unlikely. Overcoming plateaus can be achieved by implementing supplementary courses and assessments.⁵ There is an increasing amount of literature that specifically examines the learning curve related to surgical operations. The learning curve, especially in the field of pediatric urology, has become a subject of increasing debate. However, there have been few reports on the learning curve of hypospadias treatment, particularly in Indonesia.

For this study, we selected the success rate of hypospadias repair (defined as the presence of a properly positioned meatus and a normal urine flow without any complications) as the primary outcome, after carefully considering several factors. Hypospadias correction is a surgical procedure that addresses both functional and esthetic aspects. Standardizing the aesthetic results is challenging,

thus we did not consider familial or physician satisfaction with the cosmetics as a reliable measure of outcome. Although many journals highlight the learning curve using operation time as a significant outcome, we decided not to utilize it in this study because each hypospadias case has unique characteristics that necessitate a personalized strategy and treatment, making direct implementation of a learning curve impractical.

Our study found that as the surgeon gained more experience in handling and treating patients, the complication rate decreased with time. This was evidenced by a consistent improvement in the success rate of repairs. After accumulating experience from 30 hypospadias cases, we saw a substantial reduction in the surgical complication rate of the three fellows. The number of cases with complications decreased from 8, 8, and 7 cases to 4, 4, and 3 cases, for fellow A, B and C respectively. Our study revealed that the acquisition of skills in hypospadias repair by 3 fellows reached a state of relative plateau after around 45 instances, indicating a stabilized learning curve. A study conducted by Hisamatsu et al. revealed similar findings, showing that the learning curve reached a plateau in the outcomes after 50 cases.⁶ Similarly, Rompre et al. found that it took around 50-75 instances to achieve a stable negative exponential curve, with a consistent improvement in surgical outcomes without quickly reaching a plateau. The author also asserts that despite undergoing extensive fellowship training, which includes exposure to various hypospadias procedures under the guidance of experienced surgeons, urologists may still face a challenging learning period when starting their own practice. This can result in a notably higher occurrence of complications.⁷ On the other hand, Horiwitz et al

conclude that around 80-90 cases of hypospadias repair are needed to reach a relative plateau in the results.³

The majority of cases in our study were classified as proximal hypospadias, accounting for 57.9%. The content of this presentation had resemblance to the research conducted by Abdurrahman in Indonesia.⁸ In contrast, the population examined in other studies conducted in different countries exhibits notable distinctions. For instance, the studies conducted by Rompré et al. and Horowitz predominantly consisted of patients with Distal and Midshaft hypospadias, respectively.^{3,7} This pattern can likely be attributed to the fact that the majority of patients in this study were referred from a tertiary hospital, where a significant number of distal cases had already received treatment, and only complex cases were referred to our hospital.

There were a few limitations in our study. Due to the limited time and sample size, there was a variation in surgical exposure across the patients, resulting in varied procedures potentially affecting the outcome.⁹ Future research should incorporate additional evaluation of other risk variables that could potentially influence the outcomes, including the width of the glans, the length of the urethra, any pre-hormonal treatment and etc.¹⁰⁻¹²

CONCLUSION

Significant improvement of hypospadias repair success rate was observed among paediatric urology fellows after performing 30 consecutive hypospadias repair during their training. This improvement suggests that the fellowship program likely played a pivotal role in accelerating their learning curve.

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