

Impact of changing trends in technique and learning curve on outcome of hypospadias repair: An experience from tertiary care center

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ABSTRACT

Introduction: Apart from numerous clinical factors, surgical experience and technique are important determinants of hypospadias repair outcome. This study was aimed to evaluate the learning curve of hypospadias repair and the impact of changing trends in surgical techniques on the success of primary hypospadias repair.

Materials and Methods: We retrospectively analyzed data of 324 patients who underwent primary repair of hypospadias between January 1997 and December 2013 at our center. During the initial 8 years, repairs were performed by multiple 5 different urologists. From 2005 onwards, all procedures were performed by a single urologist. The study cohorts were categorized into three groups; Group I, surgeries performed between 1997–2004 by multiple surgeons, Group II, between 2005–2006 during the initial learning curve of a single surgeon, and Group III, from 2007 onwards after completion of the learning curve of the single surgeon. The groups were compared in respect to surgical techniques, overall success and complications.

Results: Overall 296 patients fulfilled the inclusion criterion, 93 (31.4%), 50 (16.9%), and 153 (51.7%) in Group I, II, and III, respectively. Overall success was achieved in 60 (64.5%), 32 (64%), and 128 (83.7%) patients among the three groups respectively ($P < 0.01$). Nineteen (20.4%), 20 (40%), and 96 (62.7%) patients underwent tubularized incised plate repair in Group I, II, and III, with successful outcome in 12 (63.2%), 15 (75%), and 91 (94.8%) patients, respectively ($P < 0.01$). The most common complication among all groups was urethrocutaneous fistula, 20 (21.5%) in Group I, 11 (22%) in Group II, and 17 (11.1%) in Group III.

Conclusion: There is a learning curve for attaining surgical skills in hypospadias surgery. Surgeons dedicated for this surgery provide better results. Tubularized incised plate urethroplasty appear promising in both distal and proximal type hypospadias.

Key words: Hypospadias, learning curve, subspecialty-based practice

INTRODUCTION

Hypospadias is a common congenital anomaly with an estimated incidence of 1 in 250 male births.^[1] The fact that more than three hundred different operations

are described in the literature is a testament to the fact that treatment has not been standardized. There have been many technical changes in hypospadias repair over time, starting from the amputation of penis distal to the meatus to the replacement of urethra by tissue culture techniques.^[2] The goal of hypospadias repair has also evolved from mere reconstruction of neourethra and chordee correction to better aesthetic and functional outcomes. In today's era,

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even negligible residual curvature and torsion are not acceptable.

In 1994, a new era in hypospadias surgery began when Warren Snodgrass described his technique of tubularized incised plate urethroplasty (TIP), a relatively straightforward one-stage procedure, which offered excellent cosmetic and functional results.^[3] Since then, this technique has become a commonly used method for hypospadias repair.

Beyond technique, successful hypospadias surgery is truly a reflection of the surgeon's experience and a positive correlation exists between surgeon experience and outcomes of hypospadias repair.^[4] Hence, appropriate techniques –and their mastery are the most important prerequisites for a successful outcome. Davis^[5] long back said that “I believe the time has arrived to state that the surgical repair of hypospadias is no longer dubious, unreliable, or extremely difficult. If tried and proven methods are scrupulously followed, a good result should be obtained in every case. Anything less than this suggests that the surgeon is not temperamentally fitted for this kind of surgery.”

It is difficult to quantify the level of experience required to provide satisfactory results in hypospadias repair. One way of measuring adequate level of skill is the completion of the learning curve, i.e., to attain a plateau level of successful outcome or when the complication rates and outcomes become stabilized. We evaluated the impact of changing trends in technique and learning curve on the outcome of hypospadias repair at our center.

MATERIALS AND METHODS

All patients who underwent primary hypospadias repair (single/staged) between January 1997 and December 2012 with a minimum follow-up of 1 year were included for this retrospective study. All failed hypospadias repair, where the primary surgery was performed elsewhere were excluded from the enrollment. Patients with follow-up less than 1 year or incomplete data availability were further excluded from the study.

During initial 8 years, repairs were performed by five different urologists (Group I), whereas from 2005 onward all procedures were performed by a single pediatric urologist. Data were analyzed on yearly basis. Study populations were categorized into three groups: Patients who underwent hypospadias repair during 1997–2004 (Group I, multiple surgeons), those repaired during 2005–2006 (Group II, during initial learning curve of single surgeon), and cases from 2007 onward (Group III, after completion of learning curve of a single surgeon).

Classification of hypospadias and various surgical techniques

The type of hypospadias was classified as distal (DP), mid (MP), and proximal penile (PP) depending on the location of meatus following degloving of the penis and/or releasing of ventral fibrous band when present. Surgical techniques used were perimeatal flap repair (Mathieu's flip-flap)/meatal advancement and glanuloplasty, TIP urethroplasty {Snodgrass}, preputial flap (onlay/), preputial tube urethroplasty, and buccal mucosal graft augmentation with tubularization and Byar's flap repair.

Definitions of outcome

Success was defined as the ability to achieve an optimal caliber neomeatus at the tip of the penis without any postoperative complications requiring subsequent intervention after primary hypospadias repair.

Failure was defined as the inability to achieve neomeatus at the tip of the penis or other surgical complication, including urethrocutaneous fistula (UCF), dehiscence, neomeatal/urethral stenosis, regression of neomeatus, and penile torsion. Dehiscence was noted as a complete disruption of anastomoses or partial disruption of anastomoses with meatal location proximal to corona at shaft. Neomeatal stenosis was reported when patients require meatal dilations or meatoplasty postoperatively. Regression of neomeatus was defined as a partial distal dehiscence with a final meatus located at proximal glans or at corona. Penile twisting more than 15° was considered as significant penile torsion.

Completion of learning curve was defined as attainment of plateau in terms of successful outcome [Figure 1].

Follow-up protocol

Follow-up included 3 monthly visits for a minimum of 1 year after repair followed by 6 monthly visits for the next 2 years and review follow-up at puberty.

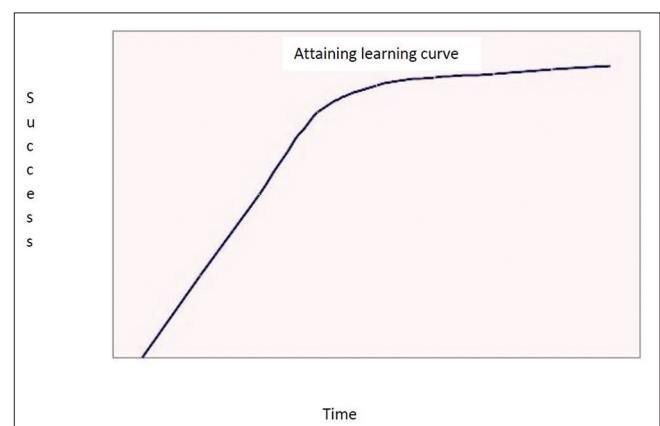


Figure 1: Learning curve

Statistical analysis

Data were presented as a mean, median, or percentage as indicated. One-way ANOVA was used for comparing variable between three groups. Univariate and multivariate logistic analysis was done to determine the influence all covariates on the outcome of surgery which include the age of the child at first operations, type of hypospadias, operative techniques, suture material used, size of catheter, and surgeons' experience. *P* values < 0.05 were considered statistically significant. Statistical analysis was done using SPSS version 17 (SPSS Inc., Chicago, IL, USA).

Surgical techniques

TIP has been the most common procedure from 2005 onwards. The basic technique of TIP has remained the same over the years with few minor modifications. Liberal mobilization of glans wings and avoiding incision of the urethral plate near the neomeatal tip to prevent the meatal stenosis have been used after the 1st year of surgical experience. Subsequently, double dartos overlapping flap or single dartos layer augmented with tunica covering has also been introduced to decrease the incidence of UCF.

Chordee was corrected in all cases when indicated (>20° ventral curvature on intraoperative artificial erection), with dorsal plication only and or excision of ventral fibrous tissue or urethral plate in cases of severe chordee. All repairs were buttressed with dartos or tunica vaginalis flap.

4-0 or 6-0 absorbable sutures were used, either polyglactin or polydioxanone. All repairs were performed over a 6–10 F silastic catheter, which was secured to the glans penis and the penis was dressed with a gentle compressive transparent dressing. The catheter remained *in situ* for 8–10 days. Antibiotics were administered from before surgery to the day of catheter removal.

RESULTS

Data of 324 patients was reviewed and data of 296 patients was analyzed finally after fulfilling the inclusion criteria. 93 (31.4%) patients were in Group I, 50 (16.9%) in Group II, and 153 (51.7%) in Group III. The overall mean age at the time of repair was 2.9 years (range: 9 months–16 years). The hypospadias type was distal in 116 patients (39.2%), mid in

58 patients (19.6%), and proximal in 122 (41.2%) patients. Mean age, type of hypospadias, presence of chordee, and number of staged procedures in primary repair were statistically comparable among three groups [Table 1]. Overall success was achieved in 60 (64.5%), 32 (64%), and 128 (83.7%) patients among Group I, II, and III, respectively (*P* < 0.01).

Nineteen (20.4%), 20 (40%), and 96 (62.7%) patients underwent TIP repair in Group I, II, and III, with successful outcome in 12 (63.2%), 15 (75%), and 91 (94.8%) patients, respectively (*P* < 0.01). Results comparing various surgical techniques and their success are depicted in Table 2. Thirty-three (35.5%), 18 (36%), and 25 (16.3%) patients in Group I, II, and III, respectively failed (*P* < 0.01). The most common complication among all groups was UCF; 20 (21.5%) in Group I, 11 (22%) in Group II, and 17 (11.1%) in Group III [Table 3].

On univariate analysis, the meatal location (*P* = 0.04) type of surgery (*P* = 0.01) and surgeon's experience (*P* < 0.01) were significantly associated with the outcome. On multivariate analysis, only the surgeon's experience was significantly associated with the outcome of hypospadias repair. While comparing various techniques in three groups, we found the success of TIP was significantly higher (*P* = 0.001) in Group III.

DISCUSSION

Perhaps no surgical concern in history has inspired such widespread and varied opinion with regard to management as has hypospadias.^[6] Duckett defined hypospadiology as “the in-depth study of the art and science of the surgical correction of hypospadias.”^[6,7]

The distribution of meatal location in our study is similar to that in literature although we had a higher proportion of proximal type. The cited incidence of DP, MP, and PP are 50%, 20%, and 30% respectively, while our patient population had distribution of 39%, 20%, and 41%, respectively.^[8] There are several possible explanations. The literature reports disease incidence in the general population while patients referred to tertiary care centers have a different spectrum with more complicated cases (PP) presenting at a higher

Table 1: Comparison of various parameters among groups

Group	Mean age (years)	Number of patients	Type of hypospadias (DP/MP/PP)*	Presence of chordee (%)	Total number of surgery (1/2)	Complications (% of total)	Complications (in type of hypospadias) (DP/MP/PP)*
I	3.2	93	38/13/42	60 (64.5)	83/10	33 (35.5)	8/6/19
II	3.9	50	19/13/18	30 (60)	43/7	18 (36.0)	5/5/8
III	2.2	153	59/32/62	100 (65.4)	130/23	25 (16.3)	6/4/15
<i>P</i>	0.59	-	0.12	0.46	0.11	<0.01	-

*DP=Distal penile, MP=Mid-penile, PP=Proximal penile

Table 2: Results of various surgical techniques among three groups

Type of surgery	Success/total repair (% success)			P
	Group I	Group II	Group III	
Perimeatal flap repair (Mathieu's, flip-flap)/MAGPI*	21/28 (75.0)	7/11 (63.6)	8/10 (80)	0.09
TIP [§] (Snodgrass)	12/19 (63.2)	15/20 (75)	91/96 (94.8)	<0.01
Preputial flap (onlay/asopa)	16/27 (59.)	5/9 (55.6)	11/17 (64.7)	0.7
Preputial tube	3/5 (60.0)	1/2 (50.0)	1/2 (50)	0.09
Single stage BMG [®] augmentation	2/4 (50.0)	0/1 (0)	2/5 (40)	0.12
Staged BMG [®] augmentation with tubularization	4/7 (57.1)	3/5 (60)	11/17 (64.7)	0.09
Byar's flap repair	2/3 (66.6)	1/2 (50)	4/6 (66.6)	0.2
Total	60/93 (64.5)	32/50 (64)	128/153 (83.7)	<0.01

*MAGPI=Meatal advancement and glanuloplasty, [§]TIP=Tubularized incised plate urethroplasty, [®]BMG=Buccal mucosal graft

Table 3: Complications among groups

Groups	UCF*	Dehiscence	Stenosis	Others (meatal regression, torsion)	Total
I	20	7	3	3	33
II	11	2	3	2	18
III	17	3	4	1	25

*UCF=Urethrocutaneous fistula

frequency. Second, the figures reflect those patients who had surgery and not simply those who were diagnosed. It is well known that mild varieties of hypospadias do not interfere with urination in standing position or fertility. Fichtner *et al.*^[9] reported a 13% hypospadias rate in a screening of five hundred men for meatal location.

In this study, we tried to determine the impact of changing trends in the technique of hypospadias repair on its surgical outcome over 15 years in a single center. Apart from technical modifications, subspecialty-based practices were followed since 2005 onwards and hypospadias was operated by a single surgeon who was working exclusively in the field of pediatric urology. Outcome analysis would probably be incomplete without taking into consideration the impact of learning curve and specialist surgeon experience. Our study was designed to evaluate both features simultaneously. Although there is a study regarding the learning curve of hypospadias surgery in literature,^[4] but to the best of our best knowledge, we could not find any article assessing the impact of changing techniques on the outcome of hypospadias repair. This study is unique in the context of evolving surgical trends and subspecialty-based practice in hypospadiology. When learning a new procedure, performance tends to improve with experience, and

graphically plotting performance against experience produces a learning curve.^[10-14]

In our study, none of the surgeons in Group I had surpassed the learning curve and after beginning subspecialty-based practices, it took nearly 2 years with surgical exposure of around fifty cases to attain outcome that was comparable to standards and as stated by Horowitz and Salzhauer,^[4] even in centers with subspecialty practice, successful hypospadias repair, as measured by complication rates, improves statistically with time and experience. Similarly, Rompré *et al.*^[15] have demonstrated that there was a positive impact of surgeon experience on the outcome of TIP urethroplasty for hypospadias repair. They found that TIP complication rate stabilized after 50–75 cases. Since its inception, TIP urethroplasty procedure has been the technique of choice in distal forms of hypospadias with sufficient urethral plate and good glandular tissue because of its reliability and high success rate.^[16,17] In a literature review, the overall complication rate of TIP in distal hypospadias ranged between 0% and 23%, with an average of 7%.^[18]

Of the many techniques for proximal hypospadias repair with or without preservation of the urethral plate, two-stage repair, TIP, and onlay urethroplasty provide satisfactory functional and cosmetic outcome, with no statistically significant differences and similar complication rates.^[19,20] However, the two-stage repair is dependable when a full circumference urethroplasty is required or when the urethral plate is of dubious quality.^[21] It is particularly appropriate for severe hypospadias associated with a poor plate and chordee.^[22]

In our study, among Group III, 49, 26, and 21 cases of DP, MP, and proximal hypospadias underwent TIP repair with success in 47 (95.9%), 25 (96.1%), and 19 (90.4%), respectively. Patients with poor urethral plate underwent onlay or substitution urethroplasty. We found that the outcome becomes satisfactory after standardization of techniques with TIP being the most commonly performed procedure in a wide variety of hypospadias. In a similar fashion to our study, Eliçevik *et al.*^[23] published the results of 360 TIP repairs performed in 5 years by seven surgeons and noted that the complication rate decreased from 35% to 15% over a period of time. Along with experience, he describes some technical tricks that helped in the decrease of the complication rate. The improved outcome of TIP as compared to other technique is likely to be related to the experience of the author with the same and few technical modifications as described. Moreover, there was significant impact of learning curve on the outcome. Although it is difficult to quantify the exact number of cases required to attain learning but arbitrarily an experience of fifty cases is required to provide optimal results.

We would like to highlight a few limitations of our study. Apart from retrospective single-center study, there was

heterogeneous group of surgeons in Group I with variable surgical exposure, different techniques might have an impact on the outcome. Moreover, there were no standardized parameters to directly measure the proficiency or completion of a learning curve which has been measured indirectly by attainment of plateau in terms of successful outcome. Although the TIP has been popularized in last one decade owing to technical ease, reproducibility and satisfactory outcome as evident in literature,^[16,17] yet many surgeons produce excellent results with other techniques too.^[20] Hence, shifting from one technique to another technique may be individual preference and it may be a viewpoint of the authors of this study on the basis of their experience and technical soundness with TIP. Variable suture materials, suture size and different sized catheter used could be other confounding factors as well.

CONCLUSION

There is a definite “learning curve” for attaining optimal results in hypospadias repair. Subspecialty-based practices should be encouraged. A shift in surgical techniques toward tubularized incised plate urethroplasty has improved the overall outcome of hypospadias surgery.

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Conflicts of interest

There are no conflicts of interest.

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