International Surgery Journal
Mishra A. Int Surg J. 2020 Sep;7(9):2868-2874
http://www.ijsurgery.com
pISSN 2349-3305 | eISSN 2349-2902

DOI: http://dx.doi.org/10.18203/2349-2902.isj20203490

Original Research Article

Hypospadias surgery: a single centre study to compare different techniques with special emphasis on transverse prepucial onlay island flap urethroplasty

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Received: 14 July 2020
Revised: 25 July 2020
Accepted: 28 July 2020

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ABSTRACT

Background: Urethroplasty for hypospadias is a difficult surgery in the best of hands. One stage surgery is usually preferred for its multiple benefits. Many techniques exist each with its own merits and demerits. Aim of the study was to compare different techniques in hypospadias surgery with special emphasis on transverse prepucial onlay island flap urethroplasty.
Methods: All children operated for hypospadias from the period of 2016-2019 in Department of Surgery at Geetanjali Medical College and Hospital, Udaipur were included in the group after obtained approval from institutional ethical clearance commitee. The technique to be used was decided on a case to case basis depending mainly on the position of the meatus, size of the urethral plate and chordee (ventral curvature). All patients were analyzed for various complications and overall success rate.
Results: 77 patients were operated and analyzed. Overall the study could not establish the superiority of one technique above another. At the same time it establishes the versatility, satisfactory results and low complication rate of transverse prepucial onlay island flap (TPOIF) in different types of hypospadias.
Conclusions: Success in urethroplasty depends on proper case selection, meticulous technique, a buttressing layer wherever possible and that TPOIF is a versatile technique for single stage hypospadias repair in distal, mid and proximal penile hypospadias.

Keywords: Staged urethroplasty, Transverse incised plate, TPOIF, Urethroplasty

INTRODUCTION

The goal of hypospadias surgery is to create a normal looking straight penis with: comfortable and complete voiding, good and straight stream of urine in upright voiding with no splaying, slit like vertical meatus, absence of torsion and chordee and reduce the risk of complications.[1,3]

These are ideal benchmarks and final result many times may be less than perfect. One stage repair is favored for obvious reasons of reduced admissions, less anesthesia risk, operating in virgin tissue and overall economic and psychological benefits. The classification used for hypospadias was standard, i.e. anterior (glanular, coronal, sub coronal), middle (distal, mid and proximal penile) and posterior (penoscrotal, scrotal, perineal) penile hypospadias.[1]

In this study we have compared three different popular techniques namely TIP (transverse incised plate) urethroplasty also called Snodgrass urethroplasty, TPOIF

(transverse prepucial onlay island flap or simply onlay) urethroplasty and staged surgery also called Bracka's technique for their results and complications. We have also tried to assess the use of increasingly popular TPOIF technique in different types of hypospadias. Standard techniques were used and are briefly described later.

The important modifications used were; no use of lignocaine and adrenaline mixture in any case, minimal use of tourniquet, limiting it to glans dissection, avoidance of dorsal plication as far as possible, use of silicone Foley's catheter, and use of oxybutinin in most of the patients.

Complications assessed were edema or hematoma formation, fistula, meatal or urethral stenosis/stricture, breakdown of repair (glanular/complete), residual chordee or torsion, urethral prolapse, skin flap necrosis, shape of the meatus, urine stream and finally need of re-surgery. Objective of this study was to compare different techniques in Hypospadias Surgery with special emphasis on TPOIF urethroplasty.

METHODS

This study was conducted in Department of Surgery at Geetanjali Medical College and Hospital, Udaipur during 2016-2019 after obtaining approval from institution ethical clearance committee. All cases of hypospadias were included except glanular and scrotal/perineal variety as according to us the former do not need surgery in majority of cases and the latter usually forms a distinct subgroup of ambiguous genitalia/intersex. The classification was done on the basis of position of the meatus after degloving of the penis. In cases of very small phallus, we gave an intramuscular testosterone injection of 25 mg (1-2 mg/kg/dose), which was repeated after 1 month if required. Surgery was done 1 month after the last dose (maximum 3 doses). Artificial erection test was done in very few patients and only when doubt existed about persistence of chordee. Technique selection was mainly on the basis of the final position of meatus (after degloving), size of the urethral plate and persistence of chordee after degloving. In many cases, the planning was possible before surgery (better under anesthesia), where presence of a relatively poor urethral plate (<5 mm) and/or short plate contributing to chordee with "bow string" effect was obvious, and underwent staged surgery. In these cases if chordee was corrected by excision of the plate, full degloving was done in the second stage. Otherwise degloving and dorsal plication if required was done to correct chordee in the first stage. Cases where initially single stage was planned, if chordee was more than 30 degrees (after degloving) also underwent staged procedure. Dorsal plication was avoided as far as possible. In cases of proximal hypospadias, staged procedure was used more commonly. Our main emphasis technique TPOIF was tried in different types of hypospadias except subcoronal and penoscrotal varieties. Lignocaine and adrenaline combination though popular was not used in any case. We used Vicryl (polyglactin) sutures in all cases. In some cases Vicryl Rapid was used depending on the availability. Polydiaxonone (PDS) sutures were not used in any case. In all cases, we used silicone catheters for an average duration of 10 days. Compression dressing was used in all cases and dressing changed only if dirty, wet or blood stained. All patients received amoxycillin and clavulanic acid (50-100 mg/kg/day in 3 divided doses) and amikacin (15 mg/kg/day in 2 divided doses) for 5 days then switched to oral medication for a further 10 days. Most of the patients were given oxybutinin hydrochloride in the dose of 0.2 to 0.4 mg/kg/dose three times a day till the catheter was in situ. For younger patients it was crushed and dissolved in water. Patients wanting an early discharge were sent home on oral antibiotics and continued for 5 days after catheter removal. Post-operatively the patients were first assessed 3 weeks after catheter removal and calibrated with suitable infant feeding tube if stream was poor in any case and in all cases of TIP and staged (Bracka's) technique. Further assessment was done at 6 weeks, 3 months, 6 months and 1 year post-operatively, and then on yearly basis for further 2 years. Patients requiring regular dilatations were called earlier as per requirement, usually at 3 week interval.

We have described the techniques one by one in brief. For the TIP technique, presence of at least 7-8 mm wide urethral plate was the main prerequisite and was used for subcoronal, DPH and MPH variants. After marking and preserving the required urethral plate, complete degloving was done till the base of penis leaving a 5-6 mm subcoronal collar. Proximally, thin ventral urethral skin was opened till thick healthy urethral tissue with *C. spongiosum* was reached. Corpus spongiosum was mobilized on both sides till easy approximation was ensured. We took a thin sub-layer of buck's fascia for additional strength with the *C. spongiosum*. Glans wings were adequately mobilized. Urethral plate was incised in midline to ensure a 1 to 1.5 cm wide plate to accommodate at least a 10 F catheter. The urethral plate incision was carried few mm proximal to the intended meatus and distally few mm short of the tip of the glans. Tubularization was done over silicone Foley's catheter by running and interlocking sutures taking good bites of mobilized *C. spongiosum* and fascia using vicryl 5-0 or 6-0 sutures. Suturing was stopped 5-6 mm proximal to the terminal part of the incision. Dartos cover was given in a tension free manner after adequate dissection to avoid torsion. Glansplasty was completed. Neomeatus was sutured to the glans ridges by 2-3 sutures if the edges were easily visible.[1-5]

For TPOIF, the initial steps were similar to TIP technique except that *C. spongiosum* was not mobilized.[6,7] The minimum native urethral plate width requirement was taken as 6-7 mm. (lesser width cases were operated by staged technique). Flap is marked on the inner prepuce with length corresponding to the plate to be covered. Flap is mobilized along with its vascular (dartos) pedicle which is dissected up to the pubic tubercle to prevent

tension and later torsion.[6] Tourniquet is applied and glans wings mobilized. Proximal anastomosis was done with few interrupted inverting vicryl 5-0/6-0 sutures taking good bites including *C. spongiosum*. One side is sutured till the end of incised urethral margin by continuous full thickness sutures. The opposite side was sutured in similar fashion preferably with subcuticular continuous inverting sutures. Some surgeons suture till corona and then dissect glans wings after applying tourniquet. This decreases tourniquet time, but carries some risk of suture loosening.[6]

The side of the pedicle gets automatically covered. On the other side a buttressing layer of dartos is given by advancing the dartos pedicle laterally with a few interrupted sutures. Glansplasty is completed (midline incision like TIP procedure was made in distal urethral plate in 5 cases of MPH.[6] The neourethra is sutured to the glans margin with few 6-0 vicryl sutures. Dorsal prepucial skin was incised in the midline and both flaps rotated for ventral skin cover (Byre's flaps) Figure 1a-g.

The third technique, Bracka's urethroplasty was done in proximal, peno-scrotal and other varieties of hypospadias with very narrow urethral plate (<6 mm) or the plate needed excision due to severe chordee. Inner prepucial skin graft was used. The graft was taken 20% larger than the required area as many of them retract. The narrow and usually fibrotic urethral plate was excised and a raw surface at least 1.5 cm was created by excising deeper and adjacent tethering tissue. Skin was not degloved in the first stage unless significant chordee was present. If chordee was there, it was corrected usually by extensive proximal degloving and sometimes by dorsal plication. Graft was defatted (but not meshed) and secured to the raw area by quilting 6-0 vicryl sutures. Prepucial defect was closed. A gauze roll or medicated dressing (bactigrass/cuticell) was fixed over the graft by prolene sutures in adjacent skin. Dressing was removed after a week. Second stage was done after a gap of at least 6 months. Degloving and tubularization was done in two layers (inner continuous interlocking and outer interrupted vicryl sutures). If a second layer was not possible, a buttressing layer of dartos was secured over the tubularized plate.[7-10] As in other cases tubularization was done over silicone catheter appropriate for age and penile size of the patient (Figures 2a-d)]. We used only prepucial graft for all our cases.

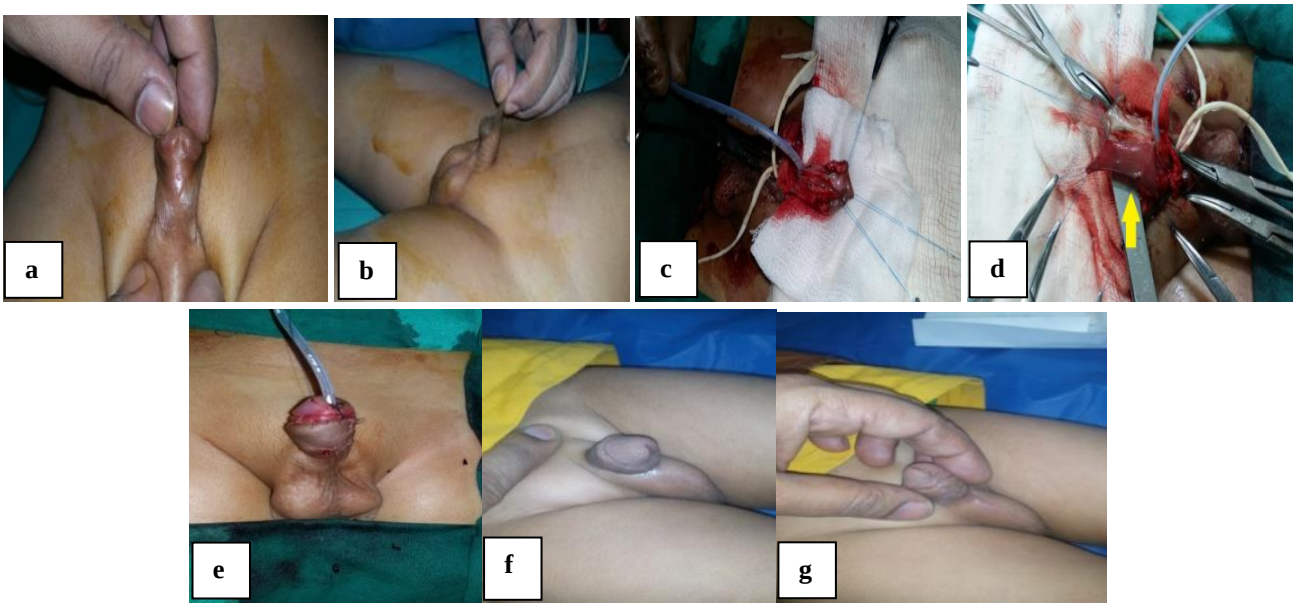

Figure 1: TPOIF procedure (a and b) pre-op condition-mid/proximal penile hypospadia with chordee, (c) urethral plate marked after degloving, (d) prepucial flap being sutured, (e) complete repair, (f and g) satisfactory results.

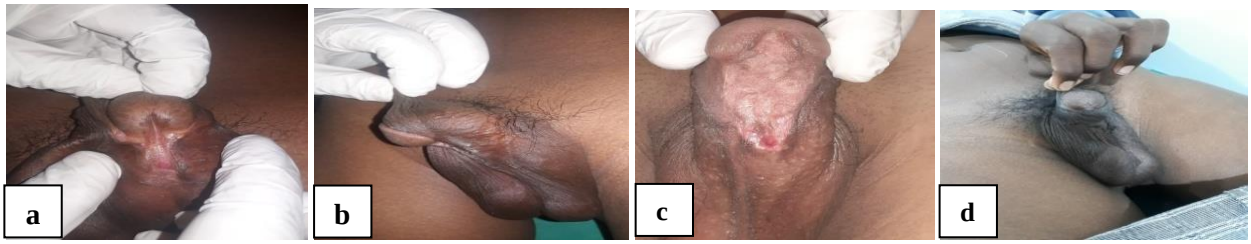

Figure 2: Bracka's staged urethroplasty, (a and b) pre-op photos showing penoscrotal hypospadias, very poor urethral plate, significant chordee, (c) after 1st stage of prepucial graft, (d): final picture after 2nd stage.

*Overall satisfactory, needed dorsal plication, slightly patulous meatus, needed urethral dilation twice under sedation due to mid urethral stenosis.

Dorsal plication was to be done in patients who had persistent chordee even after extensive degloving and/or staged surgery with excision of urethral plate. We used the standard method of bilateral dorso-lateral plication described by Baskin and Duckett, with absorbable sutures (PDS/vicryl) saving the midline neurovascular bundle.[1]

The patients were assessed for complications (listed above) in follow-up which varied from 1 to 3 years. Uroflowmetry was not done in any patient. The assessment was based on physical examination, voiding of patients whenever possible, parental history and also micturating videos made by parents at home. All patient related information remained confidential.

RESULTS

A total of 77 patients were operated by a single surgeon in the age group ranging from 18 months to 14 years from August 2016 to June 2019 (average age 4.56 years) (Table 1). The distribution of cases was as follows, 5 subcoronal, 20 distal penile (DPH), 30 mid penile (MPH), 18 proximal penile (PPH) and 4 penoscrotal. TIP urethroplasty was done in 27 patients - 5(100% of sub coronal), 15 (75% of DPH), 7 (23.3% of MPH). TPOIF urethroplasty was done in 25 patients 5 (25% of DPH), 15 (50% of MPH), 5 (28% of PPH). Bracka's staged urethroplasty was done in 25 patients- 8 (26.6% of MPH), 13 (72% of PPH), 4 (100% of penoscrotal) hypospadias respectively (Table 2).

Table 1: Age wise distribution of subjects.

Age group (years)	Number of subjects	Percentage
1-4	46	59.70
5-8	24	31.20
9-12	5	6.5
13-14	2	2.6
Total	77	100
Mean age	4.56	

Table 2: Distribution according to type of hypospadias and technique used.

Type of hypospadias	N (%)	Technique		
		TIP	TPOIF	Staged (Bracka)
Sub-coronal	5 (6.49)	5 (18.51))	0	0
DPH	20 (25.97)	15 (55.56)	5 (8)	0
MPH	30 (38.96)	7 (25.93)	15 (60)*	8 (32)
PPH	18 (23.38)	0	5 (8)	13 (52)
Peno scrotal	4 (5.19)	0	0	4 (16)**
Total	77 (100)	27 (100)	25 (100%) (32.47%)	25 (100)

* 5 out of these 15 cases had small TIP procedure done in glans (with TPOIF), ** 1 case needed dorsal plication

Table 3: Distribution according to type of complication and technique used.

Type of complication	Technique		
	TIP (n=27)	TPOIF (n=25)	Staged (n=25)
	N (%)	N (%)	N (%)
Bleeding and hematoma	1 (3.7)	2 (8)	1 (4)
Fistula	4 (14.8)*	2 (8)*	3 (12)
Urethral structure/stenosis	4 (14.8)	0	3 (12)
Breakdown of full repair	1 (3.7)	0	0
Meatal stenosis	4 (14.8)**	0	2 (8)
Urethral prolapse/ diverticulum	0	0	0
Residual chordee	0	2 (8)	1 (4)
Residual torsion	2 (7.4)	1 (4)	0
Patulous meatees	0	3 (12)	1 (4)
Superficial skin necrosis	2 (7.4)	2 (8)	1 (4)
Glanular breakdown	1 (3.7)	1 (4)	2 (8)
Angulated stream/ splaying	1 (3.7)	0	2 (8)
Redo surgery	5 (18.5)	1 (4)	3 (12)

*1 case of fistula in TPOIF and TIP each, closed spontaneously,** 2 cases of Meatal stenosis in TIP also had urethral structure.

In TPOIF, urethral plate was incised in distal part of glans in 5 patients. Only one patient of penoscrotal hypospadias needed dorsal plication. This patient underwent staged surgery and chordee persisted more than 15-20 degrees after degloving and urethral plate transaction.

The most important complication remains a fistula followed by partial or complete breakdown as many of these need redo-surgery. The overall fistula rates for TIP, TPOIF and Bracka's technique were 14.8%, 8% and 12% respectively. 5 cases of TIP procedure needed redo-surgery (3 for fistula and 2 for repair breakdown respectively). 1 case of small fistula closed spontaneously after meatal dilatation. Another small glanular fistula was merged with the neomeatus by simply incising the bridge of tissue under sedation with satisfactory results. 1 case of TPOIF needed re-operation for fistula. Another case of fistula with TPOIF closed spontaneously without any intervention. All 3 cases of fistula (on the shaft) in Bracka's technique needed closure. We would like to mention that in cases of proximal hypospadias, even if the final meatus resembled glanular hypospadias we did not reoperate (all cases had straight stream of urine). Patients with meatal stenosis required dilatation/calibration 2-3 times as an outpatient procedure and those with urethral stricture needed urethral dilatation under sedation, all at 1 month interval. Three out of four patients of Duckett's procedure (not included in the series) needed multiple urethral dilatation procedures. All patients ultimately settled down with good urinary stream. The follow up has ranged from 1 to 3 years.

DISCUSSION

Hypospadias is a technically demanding surgery with a slow learning curve. In no other procedure do all surgical principles apply as in hypospadias and shortcuts will guarantee a complication. The general guidelines are well established and documented.[1,11,12] The optimum age for elective male genital surgery is 6-12 months.[7,11]

The existence of more than 200 techniques highlights that no technique is perfect with inherent advantages and disadvantages of each. Still a few techniques are widely used because of their relative ease and reportedly lower complication rate. These are TIP (Snodgrass), TPOIF and Bracka's staged surgery. The other techniques in use are MAGPI (meatal advancement and glanuloplasty), Koyanagi, Duckett's prepucial tube urethroplasty etc. Though we used Duckett's method in 4 patients initially, it was not included in the study as it was abandoned due to relatively high complication rate of urethral stenosis in our cases.[13] In 1994, Snodgrass described TIP urethroplasty for DPH which rapidly became popular because of its simplicity even for beginners and reported low complication rate.[3] Subsequently, its use extended to more proximal hypospadias.[4,5,14]

In 1987, Elder first reported single stage repair using onlay island flap (TPOIF) which used inner prepucial skin on a vascular pedicle to cover preserved native urethral plate.[15] Though initially meant for distal and mid-penile hypospadias, its use rapidly extended to proximal ones also.[6,7] Bracka using his two stage technique published his large study of 600 cases in 1995.[16] The first stage consisted of orthoplasty, excision of native urethral plate and its substitution by free skin graft usually from inner prepuce. The second stage is done 6 months later when the new urethral plate is tubularized to form neourethra.

Broadly, we decided the technique based on position of the meatus and urethral plate characteristics i.e. its size and possibility of its preservation if chordee is present. We used TIP in DPH and MPH only. TPOIF was used in different types of hypospadias to study its reported versatility and usefulness. The results were satisfactory with low complication rates (Table 3). As far as Bracka's staged technique is concerned, Kelalis et al and Snodgrass, used the criterion that if chordee is >30 percent after degloving, the case needs a staged surgery.[11,17] In our study this assessment could usually be made before degloving considering presence of poor urethral plate (<6 mm) and/or severe chordee, and we electively used staged technique in these cases. In cases of severe chordee, if excision of urethral plate was unable to correct chordee or reduce it to a minimum (15 degrees or less), degloving was done in first stage itself (otherwise proper degloving was done in second stage). This was different from what Bracka and others, who degloved in the first stage itself.[9] Though well-defined algorithms exist for chordee correction, we avoided dorsal plication as far as possible (only 1 case).[11,12] We support the possibility of long term problems with dorsal plication in children as mentioned in some reports.[10] Following all these points, staged surgery was more commonly used in proximal cases of hypospadias.

We have tried to avoid over-enthusiastic correction of both chordee and torsion and have taken 15 degrees of either as acceptable limit. Similarly we avoided a redo-surgery if the final meatal position was slightly proximal than desired particularly in proximal hypospadias. In a good number of these cases the glans is narrow, and overcorrection will invariably result in stenosis. No corrective surgery was to be done later if the child is able to urinate in upright position without wetting his legs or had no obviously deviated urinary stream. This criteria has worked well regarding parental and patient's satisfaction and avoided another corrective surgery for these minor problems.

Complication rates have varied widely in different reports.[2,3,6,7,9,10] The most common and important complication remains urethro-cutaneous fistula. It has been reported to be between 10 to 15% in most single stage procedures.[18] Separately, it has been reported as 5 to 19% in TIP technique, from 5 to 7% in TPOIF and 5 to

18% in Bracka's staged surgery.[4,6,7,9,19,20] It should be remembered that these percentages are overall and hence will vary according to the type of hypospadias, being higher in more proximal varieties. In our study it was 14.8% in TIP, 8% in TPOIF, and 12% in Staged surgery respectively. A point seldom highlighted in different reports is the site of the fistula. In our experience, it has been most common in coronal and sub-coronal area. Not only does spontaneous closure not occur in this area, the fistula closure later is also difficult with a high failure rate. Probably in this area, lack of or thin supportive tissue including *C. spongiosum* adjacent to the urethral plate is the reason. TPOIF had low overall fistula rate (8%) and very low re-operation rate (4%) because the technique inherently ensures healthy and vascular tissue of the pedicle (dartos) as a buttressing second layer covering the suture lines.

Although the TIP technique is popular because of its simplicity and final cosmesis, it does have a higher rate of complications like fistula and stricture and requires a reasonably wide urethral plate.[7] The same was found in our study. Though some studies have reported very low complication rates with TIP.[11,21-23] Snodgrass himself has reported a high complication rate when TIP was used for proximal hypospadias.[4]

For the information of the readers, particularly the beginners, we would like to mention that during the study period, 5 cases of scrotal hypospadias were operated, all of whom had severe defect including anteriorly placed bifid scrotum. These cases need other investigations like karyotyping, USG to rule out mullerian remnants and sometimes cystoscopy/MCU to rule out a large prostatic utricle. All these cases had normal testes and underwent genital reconstruction along with staged (Bracka's) urethroplasty with successful results and relatively minor problems. For simplicity, we have not included them in our study. Four cases of peno-scrotal hypospadias were operated using Duckett's transverse prepucial tubularized pedicle technique. But it was abandoned as three cases developed urethral stenosis. Also due to small number of cases, this technique was also not included in the study.

TPOIF is a good versatile technique which can be used in widest variety of hypospadias with a low complication rate. It has been reported in many studies and same has been found in our study with a re-operation rate of 4% only.[6,7] Though we used urethral plate incision in only 5 patients of MPH operated with TPOIF technique, it appears as good modification for TPOIF and helps in tension free glanuloplasty.[6] The above paper also reports a very low complication rate with TPOIF. In an extensive review by Snodgrass, different techniques were compared vis-à-vis TIP and found similar complication rates irrespective of the technique used with overall rates higher in proximal hypospadias.[17]

We would like to highlight that we did not use lignocaine with adrenaline in any case. Complications with its use are rare but can be severe like gangrene of glans tissue. Tourniquet time was kept at minimum. We also used oxybutinin in patients whenever possible (if tolerated by patient). This and the use of silicone Foley's catheter in all cases, with its shorter length and less reactive material helped in reducing peri-catheter leak and caused less inflammation and bladder spasms, though both these problems were not reduced to zero.

Exact comparison and statistical analysis is difficult as there was a predilection to use a certain technique for different cases and a single technique was not exclusively used. Hence the number of cases for each technique varied according to the type of hypospadias and other selection criteria described above. But still a broad overall picture can emerge. One stage procedures do have distinct advantages. TPOIF is best for MPH, DPH and selected cases of PPH in which a minimum 6-7 mm urethral plate can be preserved. TIP is also a good technique for DPH and MPH provided a good urethral plate is present and which can be increased to at least 10 to 15 mm width after incising the plate. For proximal and penoscrotal hypospadias with significant chordee and/or poor urethral plate, staged technique (Bracka's) using prepucial graft is still the best though increasing studies reported good results by TPOIF in these cases also.[6,9,15,19,20]

We used prepucial free grafts in all staged surgeries, though use of buccal and bladder mucosal grafts have also been described. But they have higher complication rates and requirement of more elaborate procedures.

Overall complication rate was lowest with TPOIF with widest range of cases. TIP gave the best result as far as shape of the meatus is concerned (Figure 3 a, b), followed by TPOIF and staged surgery. This is corroborated by an extensive study by Snodgrass.[17]

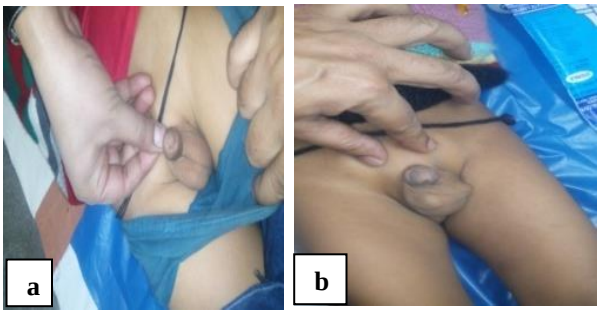

Figure 3: TIP result, (a and b) satisfactory results with well-formed vertical slit like meatus.

The dispute of single versus staged technique is long standing but consensus exists that choice of procedure is highly based on patient's individual anomaly and surgeon's preference and expertise. Ultimate surgical goal has been summarized. We consider 15 degrees each of ventral curvature (chordee) and torsion as acceptable and excessive attempts at correction can be counter-

productive. To a significant extent both these can be corrected by thorough degloving along with deep dissection of dartos pedicle if being used.

Though the series is constrained by limited number of cases as compared to other larger series and non-availability of uroflowmetry, the study establishes the versatility of TPOIF in all varieties of hypospadias except in very proximal varieties which invariably have poor urethral plate with relative limitation of length of prepucial pedicle and those in which urethral plate contributes to chordee with bow string effect i.e. all cases which need sacrificing native urethral plate.

CONCLUSION

Thus overall the study concluded that success in urethroplasty depends on proper case selection, meticulous technique, a buttressing layer wherever possible and that TPOIF is a versatile technique for single stage hypospadias repair in distal, mid and proximal penile hypospadias.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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Cite this article as: Mishra A. Hypospadias surgery: a single centre study to compare different techniques with special emphasis on transverse prepucial onlay island flap urethroplasty. Int Surg J 2020;7:2868-74.