

Evaluation of Snodgrass Technique in Primary Distal Hypospadias

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Abstract: Objective: Tubularized incised plate urethroplasty (TIP) considered to be one of the most successful operations for repair hypospadias of the distal penis. Development of neomeatal stenosis and fistula often prohibit distal lengthening of the midline incision of the urethral plate (MIUP). It remains a persistent limiting factor in apical neomeatus (NM) reformation. The raw area of the incised urethral plate (UP) was grafted with inner preputial skin during Snodgrass urethroplasty to improve the functional and cosmetic outcome of the operation. **Patients and methods:** This study included 100 cases of primary distal hypospadias. The grafted tubularised incised-plate urethroplasty (GTIP) repair was used. Standard technique of Snodgrass urethroplasty was used. Urethral plates were classified as flat, cleft, and grooved. The midline incision of the urethral plate was grafted with a free preputial skin graft and fixed to the bed with Vicryl 6/0 interrupted sutures. The urethral plate was tubularised and reinforcement of the suture line was done with Dartos flap. Urethral catheter was maintained for 14 days. Postoperatively, patients were followed-up regularly at 1st, 3rd and 6th months. Morbidity of the procedure (meatal stenosis, glandular dehiscence, and fistula formation) were recorded. HOSE system (Hypospadias Objective Scoring Evaluation) was used for validation of the outcome. **Results:** External meatus was glanular in 8, coronal in 56, subcoronal in 30, and distal penile in six patients preoperatively. Urethral plate was flat in 32%, cleft in 40%, and grooved in 28%. Width of the urethral plate was >7 mm in 82 cases and <7 mm in 18. Operative duration was 90 - 120 (mean 102) min. No observed postoperative morbidity results from prolonged anesthesia time. Achievement of an apical neomeatus was perfect in 93% of the patients. Urethrocuteaneous fistula incidence was 4%, all of them occurred in cases with <7 mm urethral plate (P = 0.001). Failed calibrations with 8 Fr catheter was more common in patients with <7 mm urethral plate compared with those >7 mm (P = 0.01). Graft and suture tracks were present at the edges of the neomeatus in 3% and 4% of patients, respectively. Cosmetic and functional results were satisfactory in 96% of the cases at HOSE scores of >14. Higher fistula rate and cannulation failure with 8 Fr were encountered in patients with flat urethral plate. **Conclusion:** The grafted tubularised incised-plate urethroplasty repair is a simple and straightforward technique for construction of properly sited apical neomeatus, with an optimum outcome according to HOSE scoring system.

[Ahmed El-Shamy. **Evaluation of Snodgrass Technique in Primary Distal Hypospadias.** *J Am Sci* 2017;13(5):116-125]. ISSN 1545-1003 (print); ISSN 2375-7264 (online). <http://www.jofamericanscience.org>. 12. doi:[10.7537/marsjas130517.12](https://doi.org/10.7537/marsjas130517.12).

Keywords: Grafted tubularized incised plate urethroplasty, Primary hypospadias

Abbreviations: G-TIP, Graft-tubularized incised plate; HOST, Hypospadias Objective Scoring Evaluation; MIUP, Midline incision of the urethral plate; NM, Neomeatus; NU, Neourethra; TIP, Tubularized incised plate; UCF, Urethrocuteaneous fistula; UP, Urethral plate

1. Introduction

The tubularized incised plate (TIP) technique is the accepted universal reconstructive repair of distal primary and sometimes proximal hypospadias, with ultimate functional and cosmetic outcomes in most cases. It is introduced by Snodgrass and his colleagues [1], and certainly has been revolution in surgery of hypospadias [2]. It is highly recommended as the procedure of choice in the repair of distal penile hypospadias. It has shown superb results in the surgical treatment of primary, redo, distal, and proximal hypospadias [3]. The profound midline incision of the urethral plate (MIUP) is the corner stone of its success but still its extension distally into the glans is not universally accepted owing to the

occurrence of stenosis of the meatus. This predominately remains the major limiting factor for reconstruction of the neomeatus (NM) at the summit of the glans.

The characters of the urethral plate and its effect on the success of tubularized incised plate have been studied. While many authors have stressed on the importance of the plate characters in TIP successful repair [4], others have shown that the technique is suitable for all cases of distal hypospadias without significant concern for the urethral plate configurations [5]. Aboutaleb [6] get inspired with these studies and undertake a study and examined the possible role of the urethral plate characters in the success of TIP urethroplasty. He get the conclusion of

TIP urethroplasty can be used for distal primary penile hypospadias with satisfactory results. Using this operation with urethral plates >8 mm and with deep grooved or cleft plates produces very good results. Flat plates and plates <8 mm may need increment by buccal mucosal graft (BMG) which is advised by some authors to increase the success rate in this group of patients.

The placement of additional inlay graft at the raw surface of the urethral plate has been proposed for modification of the healing process and improvement of the results of the operation [7]. Thus, graft placement on the incised urethral plate has been introduced to reduce the expected complications results from distal extension of the MIUP and in patients with narrow urethral plate.

To date, there has been a rarity of published experiences with large number of cases concerning graft-specific complications along with outcomes [8]. The hypothesis that the grafted tubularized incised plate (G-TIP) urethroplasty procedure with distal extension of the MIUP in grafted TIP (G-TIP) repair has more favorable results (concerning functional and cosmetic outcome) than the original TIP procedure reported with Snodgrass urethroplasty. The present study investigated G-TIP procedure and evaluate its applicability as the procedure of choice to all distal primary hypospadias cases. The critical details that potentially results in complications will be analysed to spot light the feasibility and simplicity of G-TIP urethroplasty in obtaining a more anatomical neomeatus and lowering complications, e.g. meatal stenosis and fistula.

2. Patients and Methods

Between April 2013 and July 2016, 100 patients with distal hypospadias were subjected to one-stage preputial augmented urethroplasty. Inclusion criteria were distal hypospadias and intact preputial hood. Exclusion criteria were penoscrotal to perineal hypospadias, recurrent hypospadias, circumcised patients, and significant ventral penile curvature that requires division of the plate. All procedures were performed under general anesthesia with caudal anesthesia for postoperative analgesia. After preparing the genitalia and draping, the urethral plate was measured. Traction suture was applied to the summit of the glans using 5/0 polyglactin suture. Then 8 Fr catheter passed into the hypospadiac meatus.

Coronal incision was taken about 3 mm from the mucocutaneous junction and about 4-5 mm proximal to the hypospadiac opening. Penile degloving was started after that. Hemostasis achieved using bipolar electrocautery to minimize tissue necrosis. Gauze soaked in iced saline or epinephrine (1:100,000) solution or both was used. After penile degloving was

completed and penile straightening achieved, two incisions were made to create glans wings, and the length and width of the urethral plate were measured using a ruler. The key step in the procedure is a midline incision made from within the hypospadias meatus to the distal end of the plate. The incision extended through the epithelial surface of the plate deeply into underlying connective tissue down to the corpora cavernosa, with the surgeon and assistant maintaining counter-traction using fine forceps, division of the plate is observed to significantly widen it until further incision yields no additional mobility. Tenotomy scissors, rather than a knife are recommended for this maneuver so as to gain adequate depth without injuring the corpora cavernosa. Plate configuration determines the depth of this relaxing incision. When the urethral plate is flat, the incision will obviously be deeper than when the plate is already naturally grooved. After incision of the urethral plate in the midline, the incision extended distally to the glans tip. Then, stay sutures are taken at the edges of the neourethra.

Then stay sutures taken in the inner phase prepuce, and a free preputial graft harvested. The graft measured 8-12 mm in width, and varies in length according to the location of the hypospadias meatus and the length of urethral plate. Then, the preputial skin-free graft was defatted and placed on the raw incised area. 6/0 polyglactin stitches were placed in quilting manner to anchor the graft to the corpora cavernosa (**Fig. 1**). Then, the neourethra rolled around 8 Fr catheter and closed using running subepithelial 6/0 polyglactin suture. The urethral plate was tubularized by using single layer subcuticular polyglactin 6/0 sutures. After creating a second layer coverage using dartos in 85 or tunical flap in 15 patients, glanuloplasty followed, beginning at the corona and continuing distally using interrupted inverted subcuticular stitches using 6/0 polyglactin suture. The mucosal collar was approximated in the midline, then shaft skin was refashioned to simulate the median raphe, then closed by continuous 6/0 polyglactin suture.

Discharge of the patients started after 24 h with the urethral catheter left for 7 to 10 days. The patients were seen again on the 5th post-operative day for dressing and on the 7th to 10th day for catheter removal. Urethral stents were removed on the seventh postoperative day (in cases of distal) and on the tenth postoperative day (in cases of proximal hypospadias) according to the length of the grafted bed.

They were then followed-up regularly at 1st, 3rd and 6th months. Each visit included observation of the esthetic appearance, the graft viability and possible complications (such as meatal stenosis or fistula). The shape and force of the urine stream was considered.

Follow – up involved assessment of the following: parents' satisfaction, quality of micturition, pain, urinary tract infection, micturition duration, straining, spraying, direction of the stream of urine, and cosmetic appearance. Physician's evaluation: cosmesis, function, persistent curvature, complications, insufficient cosmetic result, and complications (glans dehiscence, meatal stenosis, urethral dehiscence, fistula, stenosis, persistent chordee, penile torsion, and others). The outcome was assessed using the 'Hypospadias Objective Scoring Evaluationb' (HOSE) system. Patients' urethras were calibrated with 8-10 Fr Nelaton catheter, those who appeared with symptoms of stenosis or fistula, then

dilatation program was initiated with dilatation twice daily for one month and reassessment (either closure of fistula and relief of stenosis or failure).

Statistical analysis was done using SPSS (statistical program for social science) 11.0 as follows: quantitative variables description as mean, SD and range, qualitative variables description as no and %, Chi- square test was used to compare qualitative variables, unpaired t-test was used to compare two groups as regard a quantitative variable, paired t-test was used to compare quantitative variable in the same group, P value > 0.05 is insignificant, P <0.05 is significant, P<0.01 is highly significant.

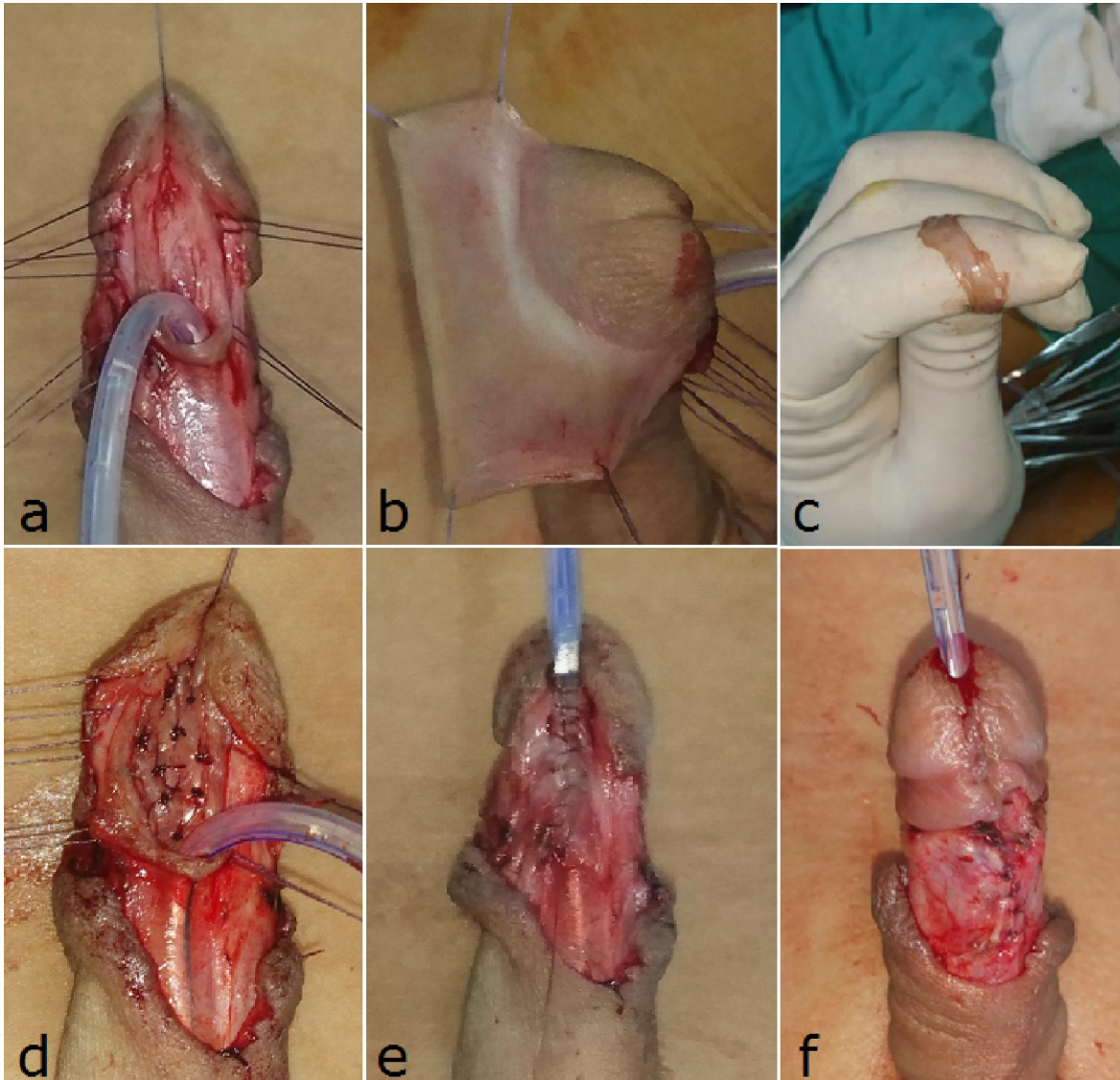


Fig. 1 a) The penis was degloved and the plate was separated from the glans. b) Stay sutures taken in the inner phase prepuce. c) Harvested free graft. d) Graft anchored to corpora cavernosa. e) The urethral plate was tubularised. F) Glanuloplasty.

3. Results

The native meatus was glanular in 8 (8%), coronal in 56 (56%), subcoronal in 30 (30%), and distal penile in six (6%) patients (**Table 1**). The mean age was 2.3 ± 0.5 (range 1–3) years over a median follow-up of 10 (6–12) months. Urethral plate was categorized as flat in 32 patients, clefted in 40 cases, and grooved in 28 cases. Urethral plate width was >7 mm in 82 cases, and <7 mm in 18 cases (**Table 2**).

Fifteen patients (15%) had mild chordee. Chordee was corrected with degloving only. Cases with moderate to severe chordee were excluded (these cases need staged repairs with increased complications rate). A slit-like apical meatus was achieved in 95 (95%) patients. Operative duration was 90 - 120 (mean 102) min. Urethral plate was preserved in all cases. The success rate was 96% without any long-standing complication throughout the follow-up period.

Table 1: Types of hypospadias

Types of hypospadias	Number (%) of patients
Glanular	8 (8%)
Coronal	56 (56%)
Subcoronal	30 (30%)
Distal penile	6 (6%)

Table 2: Urethral plate characteristics

Characteristic	Number (%) of patients
Shape	
Flat	32 (32%)
Cleft	40 (40%)
Grooved	28 (28%)
Width	
>7 mm	82 (82%)
<7 mm	18 (18%)

Table 3: Complications of the procedure

Complications	Number (%) of patients
Urethrocutaneous fistula	4 (4%)
Moderate penile angulation	3 (3%)
wound dehiscence	2 (2%)
Stricture	1 (1%)
Mega meatus	1 (1%)
Skin necrosis	1 (1%)
Residual chordee	0 (0%)
Extravasation of urine	0 (0%)
Diverticulum	0 (0%)
Flap necrosis	0 (0%)
Meatal stenosis	0 (0%)

Table 4: Objective outcome of the procedure as per HOSE system

Variable	Score	No. (%) of patients
1. Meatal location	Distal glanular	4 93 (93%)
	Proximal glanular	3 7 (7%)
	Coronal	2 0 (0%)
	Penile shaft	1 0 (0%)
	Vertical slit	2 95 (95%)
2. Meatal shape	Circular	1 5 (5%)
	Single stream	2 99 (99%)
3. Urinary stream	Spray	1 1 (1%)
	Straight	4 95 (95%)
4. Erection	Mild angulation ($<10^\circ$)	3 2 (2%)
	Moderate angulation ($>10^\circ$ but $<45^\circ$)	2 3 (3%)
	Severe angulation ($>45^\circ$)	1 0 (0%)
5. Fistula	None	4 96 (96%)
	Single (subcoronal or more distal)	3 3 (3%)
	Single (proximal)	2 1 (1%)
	Multiple or complex	1 0 (0%)

Complications were urethrocutaneous fistula in 4 (4%), moderate penile angulation in 3 (3%), wound dehiscence 2 (2%), stricture in 1 (1%), megameatus in 1 (1%), skin necrosis in 1 (1%), residual chordee, extravasation of urine, diverticulum, flap necrosis, and meatal stenosis were not recorded in any case (**Table 3**). All cases had reasonable voiding in single stream with good flow except one, acceptable cosmetics results and appearance were obtained.

The presence of suture tracks and graft at the edges of the slit-like meatus occurred in 3 (3%) and 4 (4%) cases respectively, (avoided in most cases by quilting an adequate small graft size with subcuticular sutures fixed to the inner margins of the glans and UP. Four patients developed urethrocutaneous fistula, three of which closed spontaneously, while one required surgical repair 6 months later in the presence of a wide apical neomeatus. None of the patients developed

neomeatus stenosis or needed regular urethral dilatation.

The urine stream was single good caliber and straight in 96 (96%) of the patients and three had single poor caliber and straight stream while one had a very thin stream of urine postoperatively. Retrograde urethrography which was performed only in this case, showed localized urethral stricture. Cystoscopy diagnosed stricture at the level of the urethrocutaneous anastomosis, probably resulted from extension of the MIUP and grafting into normal urethra. Endoscopic internal urethrotomy was successful without recurrence on follow-up. There were moderate penile angulation (10–30°) in three patients that had distal penile hypospadias. Appropriate cosmetic results with 96% of the patients recorded HOSE score of >14 (Table 4).

4. Discussion

Hypospadias is one of the commonest pediatric surgical diseases, with an incidence of 1/300 infant males. Among many reconstructive procedures, TIP repair submitted by Snodgrass in 1994 is the preferred technique because it is simple with satisfactory cosmetic and functional outcomes [9, 10].

The TIP technique has been widely accepted and, as experience collects, considerable series have been released with variable results. Applied in a wide spectrum of distal hypospadias, good cosmetic outcome achieved, and about 0% stenosis, 2% glans dehiscence, and 2% fistulas have been reported in a study on 551 patients [1]. But, unfortunately, not every surgeon has achieved such good results with TIP. In review of literature by Braga and his colleagues [11] of 53 published studies about TIP cases, the meatal stenosis rate ranged from 0 to 17% (mean, 2.1%), and the fistula rate was ranged from 0 to 16% (mean, 5.9%).

Among the recorded complications urethrocutaneous fistula, urethral stricture, and meatal stenosis, have been reported in literature with an incidence of 2-26% as regard to surgeon experience, small glans volume, shallow MIUP, and an incision expanded beyond the distal margin of the UP which heals by fibrosis [11-13].

In Elbakry et al. review of 16 studies [14], meatal stenosis rate ranged from 0 to 6% (mean, 3.6%), fistula rate ranged from 0 to 9% (mean 6.7%), and glanular dehiscence rate ranged from 0 to 8% (mean, 1%).

The results achieved by Mouravas et al. [15] for their TIP group exceeded the above described ranges in the occurrence of stenosis (6/23, 26.1%), perhaps because they considered as stenosis the inability to catheterize the neourethra with an 8-Fr catheter, and they do not rely on inspection of urine stream alone.

Others, who examined asymptomatic patients with urofluometry diagnosed obstructed flow in up to 66.7% of cases after TIP urethroplasty [16].

In a series of TIP procedure when prophylactic dilatations were not applied postoperatively, cases complicated with stenosis were high (6/26, 23%) [9]. These incidences suggested that stenosis may be under-estimated [17]. Stricture is the end result of inflammatory reaction and excessive granulation tissue formation at the site of UP incision. Fibroblasts maturation into fibromyoblasts causes contraction of the wound (this effect lasts until urothelium cover the surface [18].

These effects are thought to be alleviated by stenting the urethra in order to allow urothelium to cover a wider surface, although experimental data in rabbits did not give statistically significant results [19]. In clinical practice, an accidental stent detachment early in the postoperative period is likely to cause stenosis [20].

Another method for prevention of stricture formation is grafting UP raw surface. Thus the coverage of the raw surface of the UP is done immediately, stopping the granulation phase and the contraction, at the same time the graft takes effectively and maintain its original histological characteristics. This method was used originally in salvage hypospadias. This extend the application of the technique, and the graft was taken from the buccal mucosa [18, 21].

However, if the incision does not extended distally enough the cosmetic result of the neomeatus will be suboptimal (not slit-like) [1].

To optimize the outcome in such cases and among surgeons in the early learning curve many modifications to the original technique have been proposed. Modification of the TIP through grafting of the UP was suggested by Kolon and Gonzales [22] in 2000. Grafting permits immediate coverage of the incised UP with epithelialized graft and diminish the impact of a narrow UP and low glans volume, thus facilitating tubularization and glans medial rotation for reconstruction of a slit-like NM on the summit of conical glans. Similarly, Jayanthi [23] suggested distal propagation of the midline incision to the tip of the glans. He found that it make reconstruction of an anatomical apical NM easier without increased incidence of meatal stenosis. This was often not recommended in the original procedure of TIP repair. In the current study, the modifications of Jayanthi [23] and Kolon and Gonzales [22] were combined and applied in patients with primary distal hypospadias and the outcome assessment was based on postoperative complications and HOSE objective scoring.

Despite the popularity of the TIP technique, some surgeons believe that it is unsuitable for cases with a narrow plate. Extra-genital tissue is sometimes needed for fundamental augmentation of the urethral plate in cases with insufficiency of local tissue or unfavorable urethral plate (narrow, inelastic or unhealthy), especially after attempts of previous hypospadias surgery [24].

TIP repair depends on the fact that a deep MIUP guarantee its widening and hence allows a tension-free tubularization. The midline incised bed of the UP regenerate by granulation which will be followed by fibrous, which has been proposed to be a major contributing factor for the development strictures of the urethra in cases reported sometimes in the literature [25]. Similarly meatal stenosis developed from distal extension of the MIUP into the glans. This often prevents reconstruction of a neomeatus at the summit [26]. Grafting permits immediate covering with epithelialized graft and minimizes excessive fibrosis in the incised UP bed [20]. Leslie et al. [25] analyzed the functional and histological characteristics of the inlay preputial graft in experimental rabbit model. They reported that the preputial graft maintained its original histological characteristics with great graft integration, thus supposing its application in humans.

Kolon and Gonzales [22] first proposed insertion of graft in the incised UP bed with the aim of promoting healing by epithelization, and from their experience they stated that grafting prevent the development of neourethral stricture, meatal stenosis, urethrocutaneous fistula and urethral diverticulum, particularly in the presence of a narrow UP. Gundeti et al. [27] similarly reported that G-TIP urethroplasty decreases complication rates, particularly in patients with narrow UPs. Also, Shimotakahara et al. [13] reported their first prospective comparative study between TIP and G-TIP urethroplasty in 50 cases and notified a low complication rate in cases underwent G-TIP urethroplasty. They highly recommended it to be the procedure of priority in primary distal hypospadias.

Later on, Mouravas et al. [15] in 2014 reported their experience in comparative analysis of TIP and G-TIP in 47 cases and documented that results of G-TIP had lower urethral stricture and fistula rates. They recommended it as the operation of choice in cases undergoing primary distal hypospadias surgery. In a series of 102 cases underwent G-TIP, meatal stenosis was not recorded in any patient but fistula occurred in 10 patients (9.8%) [28]. In a study of a single surgeon's experience with TIP and G-TIP, cases with G-TIP were found to have significantly lower rates of fistula and stenosis [13].

Width of the urethral plate greatly affect the results of hypospadias repair. Holland and Smith reported their results of 48 cases as all cases of meatal stenosis and urethral fistulae had occurred in cases with preoperative urethral plate width less than 8 mm [29].

According to previously published studies, repair of distal penile hypospadias with a narrow UP needs alternative procedures for augmentation such as preputial-based dorsal inlay graft urethroplasty. The term "Snodgraft" was then introduced. It represented the logical progression of the original TIP procedure, with the addition of inlay graft in the dorsal incision raw area instead of leaving it to epithelialize [30].

Although experimental animal studies with incised and grafted UP showed no significant improvement of physical urethral characteristics such as flow dynamics [18], and compliance [31]. On the contrary, encouraging outcomes were observed in clinical practice after using inner preputial skin in UP grafting.

In a group of 35 cases with G-TIP urethroplasty, no patients of fistula or meatal stenosis were observed [32]. In a series of 31 recurrent and complicated patients, skin of the penile shaft or internal prepuce were used, a complication rate of 12.9% was recorded, and internal prepuce tended to perform better than penile skin [30].

Many surgeons select hypospadias patients for G-TIP on certain criteria as long spongiosum defect, small glans, flat urethral groove, and redo cases [33-35]. However, a retrospective study of 551 cases operated upon by a single surgeon has proved that no specific configuration predisposes to stricture or fistula after TIP [1].

The urethral plate shape and width are generally evaluated when the G-TIP repair is opted for the management of hypospadias. In the present study, patients with UP width >7 mm were 82 (82%), and patients with UP width <7 mm were 18 (18%). Urethrocutaneous fistula incidence was 4%, all of them occurred in cases with <7 mm urethral plate (P = 0.001). Wide urethral plate permits the creation of the NU >8 Fr after midline incision to widen the urethral plate. However, a narrow plate <7 mm is inappropriate for the creation of neourethra. This may be the cause of statistically significant higher fistula rate in cases with urethral plate <7 mm in width.

Nguyen et al. [36] recorded 3.3% incidence of urethrocutaneous fistula over (1/30 cases) with narrow urethral plate versus 0.7% incidence over (1/129 cases) with urethral plate >8 mm. Aboutaleb [6] found that cases with urethral plate <8 mm had higher statistically significant fistula rate compared with cases with urethral plate >8 mm (P = 0.004).

Comparing cases with UPs width of less than 8 mm versus wider ones, there were no significant difference observed as regards to complications [37]. In another series, depth of the urethral groove did not significantly influence fistula rate or urinary stream direction, although neourethral caliber of less than 8 mm after TIP was significantly related to increased stenosis rate [38]. Several technical factors in TIP urethroplasty have been incriminated in the development of urethral stenosis, as incision extending beyond the distal limits of the UP [39, 40] and shallow midline UP incision [41]. However, if the incision does not extend far enough the cosmetic results will be poor, contributing to none slit-like NM. Grafting the UP allows immediate coverage and decreases the effects of possible shallow incision or incision that reaches the summit of the glans.

In the current study, free preputial graft was used to cover incision of the UP along with extension of the midline incision distally to the summit of the glans. The apical NM at the summit of glans was reconstructed successfully in 93% of the patients. The incidence of UCF in the present series, irrespective of degree of hypospadias and glans size, was 4%, which is comparable to the fistula rates reported with G-TIP and TIP repairs [9, 22, 11-13, 42]. Meatal stenosis (even with distal extension of the MIUP) and urethral stricture were not present in the current series. Thus the current and reported experiences with incised UP grafting suggests that grafting prohibit fibrosis of the incised distal glans and UP by providing an immediately epithelial surface thereby ameliorates the chances of developing meatal stenosis and urethral stricture. However, in the current study there was no details and analysis of the different pathological stages of the graft take. Uptake of the graft is usually associated with hypergranulation and vertical graft contracture, which may have explain the development of residual chordee in five patients with long inlay grafts in the current study.

In the present study, cases with narrow and flat urethral plate suffered from more complications. In this context, Tavakkoli and Mohammadi [43] advocated the importance of graft with TIP repair to augment narrow urethral plate (6-8 mm). They recommended the use of graft to lower meatal stenosis and fistula rate formation. Also, Ye et al. [44] combined TIP with graft in 53 cases and harvested better outcome. Therefore, urethral plate grafting is highly recommended when the urethral plate is inelastic and/or narrow.

Four patients in the current study (4%) developed urethrocutaneous fistula, while none developed meatal stenosis or needed regular urethral dilatation. These results show that there is a place for the "Snodgraft" technique in repair of hypospadias, provided the

selection criteria listed by Ferro are met; these include an abnormal glans, long spongiosum defect and flat urethral groove [20].

The higher rate of fistula with narrow UP occurs because midline incision of the urethral plate by itself is not enough to create a neourethra with too much width around 8 Fr catheter; so urethral plate anastomosed under tension. Therefore, tubularization with increased tension on the suture line results in increased incidence of fistulae in patients with narrow urethral plate.

Meatal stenosis could be the cause of distal obstruction which predispose to fistula formation. Failure in 8 Fr calibration associated with fistula formation may be resolved with repeated dilation of the urethra. In the current study, three of the cases who developed fistula resolved with repeated dilation of the urethra.

Modification to UP midline incision by extending it down to the tip of glans may prevent meatal stenosis as described by Khairallah and Bader-Eldin; [45] however, it only decreases fistula rate and meatal stenosis to <1%.

The present study population characterized urethral plate as flat, cleft, and deeply grooved. Patients with flat urethral plate had higher fistula rate compared to the cases with cleft or deeply grooved UP; however result is not statistically significant ($P = 0.1$).

This is also in accordance with the previous studies, where no significant relation was detected between urethral plate depth and increased incidence of fistula [38]. Higher 8 Fr calibration failure rate was detected in cases with flat urethral plate in comparison to cleft and deeply grooved UP, the result is statistically insignificant ($P = 0.06$).

Hypospadias repair should be evaluated both in terms of cosmetic and functional outcomes [39, 46]. Holland and Smith [29] introduced an objective assessment scoring system (HOSE). They designed it to estimate satisfactory and functional outcome (as regard urinary stream, how straight is erection, absence of a fistula, aesthetic repair, and position and shape of the neomeatus). As the score can be calculated clinically it is simple to use, with agreement between parents and medically trained assessors. A score of 14 is recommended as an accepted outcome of hypospadias repair [39, 46]. Al-Adl et al. [46] assessed the cosmetic and functional outcomes in 43 patients underwent TIP with distal extension of the MIUP (without grafting) and achieved a HOSE score of ≥ 14 in 98% of the patients. In Gupta et al. [8] study, a cosmetic and functional outcomes that a score of ≥ 14 was achieved in 96% of patients. In the present study the Holland objective scoring system of ≥ 14 was achieved in 96% of cases

confirming that G-TIP is associated with good overall objective outcome.

An appraisal of the surgical technique from the surgeon's experience during the learning curve resulted in a few modifications to the grafting technique. In the present study, it was observed that subcuticular suturing of the graft to the inner edge of the glans prohibited the development of suture tracts at follow-up. Also, a large and bulky graft results in a visibility of the graft through the NM; so, graft thinning and re-sizing is recommended with the aim of optimizing cosmetic NM. Circumferential anastomotic stricture may occur when the graft sutured to the incised UP proximally in the native urethra, so to avoid this it is recommend to limit urethral bed grafting at the level of the local meatus only. Incision by endoscopy is recommended as the treatment of choice in such cases to avoid complications associated with re-do urethroplasty.

The current study may has limitations. There is no comparative analysis (prospective or retrospective) with TIP repair. Moreover, the width of the UP and glans size (which are obstacles for the success of TIP urethroplasty) has been taken into consideration only objectively (without mathematical calculation of the glans width and critical size of the UP). Thus, comparison with TIP urethroplasty (statistical) is indicated to detect whether grafting in TIP repair prevents or decrease incidence of UCF and urethral stricture, especially if there is limiting factors as small glans volume and/or narrow UP.

The different aspects of graft healing, with the long-term morbidity results from UP grafting, needs more assessment in terms of longitudinal graft contracture and histological changes resulting from exposure of grafted skin to the chemical nature of the urine. The current study considered to be clinically significant as a single-surgeon experience with an adequate number of patients, follow up, critical evaluation of the procedure, and evaluation of the results in terms of the HOSE system.

A non-comparative objective and assessment of the functional results in the current study in terms of an absent meatal stenosis, urethral stricture, low rate of UCF and reconstruction of NM at the glans summit warrant grafting of the incised UP with distal expansion of the midline incision in cases of primary distal hypospadias.

Many surgeons treat distal hypospadias cases in a 1-day or outpatient setting. For geographical and social reasons, this was rarely done in the present study, and perhaps results of the present study are partially affected by this fact. Accidental catheter obstruction (early) and/or removal is one of the most important incident that affect the outcome and to which outpatients are highly prone to owing to lack of

adequate supervision during early postoperative period.

It should be remembered that G-TIP cases may benefit relatively under these situations as the graft protects against urethral wound contraction, however children with TIP remain unprotected. All the above mentioned data, in opinion of the present study, as well as in the opinion of others studies [8], support the importance of the surgeon's experience, caseload, and skills on the overall results. The results of many authors cited proposed grafting, which offers immediate epithelization and supplemental safety. No demonstrated appropriate criteria have been proposed to assign a patient to grafting or non-grafting. Therefore, as not every child in the world will be operated on by a surgeon equally experienced and skillful, the following question should be addressed: Which of TIP or G-TIP is more permissive to a surgeon with imperfect performance, resulting in diminished complication rates in his hands, and which will be of benefit to the patient?

Conclusion

The extended distal incision and grafting of the UP in TIP repair is a technically straightforward and feasible technique, which can be highly considered with the aim of reconstruction of an apical NM along with minimizing the incidence of UCF and meatal stenosis. Also, proximal grafting of the incised UP into the normal urethra should be forbidden to prevent anastomotic stricture and similarly subcuticular suturing of the graft with the inner edge of the incised glans is highly recommended to prohibit suture tracks and visible graft at the margins of the NM. The present study concluded that the G-TIP procedure carries significantly low complication rates. A significant number of complications have been avoided, a fact that outweighs the extra operative time. Therefore, G-TIP can be used as the procedure of choice in distal hypospadias patients.

References

1. Snodgrass WT, Bush N, Cost N. Tubularized incised plate hypospadias repair for distal hypospadias. *J Pediatr Urol* 2010; 6:408-13.
2. Snodgrass W. Letters to the editor. Re: Urethral plate grafting improves the results of tubularized incised plate urethroplasty in primary hypospadias. *J Pediatr Urol* 2014; 10:780-782.
3. Cook A, Khoury AE, Neville C, Bagli DJ, Farhat WA, Pippi Salle JL. A multicenter evaluation of technical preferences for primary hypospadias repair. *J Urol* 2005; 174:2354-7.
4. Erol A, Baskin LS, Li YW, Liu WH. Anatomical studies of the urethral plate: Why preservation of

- the urethral plate is important in hypospadias repair. *BJU Int* 2000; 85:728-34.
5. Karakus SC, Koku N, Parmaksiz ME, Ertaskin I, Kilincaslan H, Deliaga H. The effect of urethral catheter size on meatal stenosis formation in children undergoing tubularized incised plate urethroplasty. *Urol J* 2014; 10:1095-8.
 6. Aboutaleb H. Role of the urethral plate characters in the success of tubularized incised plate urethroplasty. *Indian J Plast Surg* 2014; 47:227-231.
 7. Ninana N, Thomasb S, Grohensa Y. Wound healing in urology. *Ann Urol* 2015; 82-83:93-105.
 8. Gupta V, Yadav SK, Alanzi T, Amer I, Salah M, and Ahmed M. Grafted tubularised incised-plate urethroplasty: An objective assessment of outcome with lessons learnt from surgical experience with 263 cases. *Arab J Urol* 2016; 14(4): 299–304.
 9. Wilkinson DJ, Farrelly P, Kenny SE. Outcomes in distal hypospadias: a systematic review of the Mathieu and tubularized incised plate repairs. *J Pediatr Urol* 2012; 8:307-12.
 10. Nerli R.B., Guntaka A.K., Patil R.A., Patne P.B. Dorsal inlay inner preputial graft for primary hypospadias repair. *Afr J Paediatr Surg* 2014; 11:105–8.
 11. Braga LH, Lorenzo AJ, Salle JL. Tubularized incised plate urethroplasty for distal hypospadias: a literature review. *Indian J Urol* 2008; 24:219–25.
 12. Borer JG, Bauer SB, Peters CA, Diamond DA, Atala A, Cilento BG Jr. Tubularized incised plate urethroplasty: Expanded use in primary and repeat surgery for hypospadias. *J Urol* 2001; 165:581-5.
 13. Shimotakahara A., Nakazawa N., Wada A., Nagata S., Koga H., Takahashi T. Tubularized incised plate urethroplasty with dorsal inlay graft prevents meatal, neourethral stenosis: a single surgeon's experience. *J Pediatr Surg* 2011; 46:2370–2.
 14. Elbakry A. Further experience with the tubularized-incised urethral plate technique for hypospadias repair. *BJU Int* 2002; 89:291–4.
 15. Mouravas V, Filippopoulos A, Sfoungaris D. Urethral plate grafting improves the results of tubularized incised plate urethroplasty in primary hypospadias. *J Pediatr Urol* 2014; 10(3):463–8.
 16. González R, Ludwikowski BM. Importance of urinary flow studies after hypospadias repair: a systematic review. *Int J Urol* 2011; 18:757–61.
 17. Silay MS, Sirin H, Tepeler A, Karatag T, Armagan A, Horasanli K, Miroglu C. "Snodgraft" technique for the treatment of primary distal hypospadias: pushing the envelope. *J Urol* 2012; 188(3):938-42.
 18. Bahadır G, Ergün E, Telli O, Khanmammadov F, Çakmak AM. Hormone therapy in hypospadias surgery: a survey on the current practice in Turkey. *Turk J Med Sci* 2016; 20;46(6):1624-8.
 19. Eassa W, He X, El-Sherbiny M. How much does the midline incision add to urethral diameter after tubularized incised plate urethroplasty? An experimental animal study. *J Urol* 2011; 186 (Suppl. 4):1625–9.
 20. Ferro F, Vallasciani S, Borsellino A, Atzori P, Martini L. Snodgrass urethroplasty: grafting the incised plate – 10 years later. *J Urol* 2009; 182 (Suppl. 4):1730–4.
 21. Schwentner C, Seibold J, Colleselli D, Alloussi S, Schilling D, Stenzl A. Single-stage dorsal inlay full-thickness genital skin grafts for hypospadias reoperations: extended follow up. *J Pediatr Urol* 2011; 7:65–71.
 22. Kolon TF, Gonzales ET. The dorsal inlay graft for hypospadias repair. *J Urol* 2000; 163:1941–3.
 23. Jayanthi VR. The modified Snodgrass hypospadias repair: reducing the risk of fistula and meatal stenosis. *J Urol* 2003; 170:1603–5.
 24. Hayashi Y, Kojima Y, Mizuno K, Kurokawa S, Nakane A, Kohri K. Achieving a natural glanular meatus for distal hypospadias with a narrow and shallow plate: tubularized incised plate versus modified Barcat repair. *Int J Urol* 2008; 15(7):616–20.
 25. Leslie B, Jesus L, El-Hout Y, Moore K, Farhat W, Bägli D. Comparative histological and functional controlled analysis of tubularized incised plate urethroplasty with and without dorsal inlay graft: a preliminary experimental study in rabbits. *J Urol* 2011; 186(Suppl.):1631–7.
 26. Snodgrass W, Bush N. Primary hypospadias repair techniques: A review of the evidence. *Urol Ann* 2016; 8(4):403-8.
 27. Gundeti M, Queteishat A, Desai D, Cuckow P. Use of an inner preputial free graft to extend the indications of Snodgrass hypospadias repair (Snodgraft). *J Pediatr Urol* 2005; 1:395–6.
 28. Castagnetti M, Bagnara V, Rigamonti W, Cimador M, Esposito C. Preputial reconstruction in hypospadias repair. *J Pediatr Urol* 2017; 13(1):102-9.
 29. Holland A, Smith G. Effect of the depth and width of the urethral plate on tubularized incised plate urethroplasty. *J Urol* 2000; 164 (2):489–91.
 30. Manzoni G, Bracka A, Palminteri E, Marrocco G. Hypospadias surgery: when, what and by whom? *BJU Int* 2004; 94 (8):1188–95.

31. Jesus L, Schanaider A, Patterson G, Marchenko A, Aitken K, Leslie B. Urethral compliance in hypospadias operated by tubularized incised urethral plate (TIP) with and without a dorsal inlay graft: an experimental controlled study. *World J Urol* 2013; 31:971–5.
32. Mata N, Gutiérrez Segura C, Álvarez Muñoz V, Oviedo Gutiérrez M, Montalvo Ávalos C. Uroflowmetric review of pediatric distal urethroplasty. *Cir Pediatr* 2015; 28(1):6-9.
33. Smith J, Patel A, Zamilpa I, Bai S, Alliston J, Canon S. Analysis of preoperative antibiotic prophylaxis in stented, distal hypospadias repair. *Can J Urol* 2017; 24(2):8765-9.
34. Shuzhu C, Min W, Yidong L, Weijing Y. Selecting the right method for hypospadias repair to achieve optimal results for the primary situation. *Springerplus* 2016 Sep21;5(1):1624.
35. Gundeti M, Queteishat A, Desai D, Cuckow P. Use of an inner preputial free graft to extend the indications of Snodgrass hypospadias repair (Snodgraft). *J Pediatr Surg* 2011; 46:2370–2.
36. Nguyen MT, Snodgrass WT, Zaontz MR. Effect of urethral plate characteristics on tubularized incised plate urethroplasty. *J Urol* 2004; 171:1260-2.
37. Tam YH, Pang KK, Wong YS, Tsui SY, Wong HY, Mou JW, Chan KW, Lee KH. Improved outcomes after technical modifications in tubularized incised plate urethroplasty for mid-shaft and proximal hypospadias. *Pediatr Surg Int* 2016; 32(11):1087-92.
38. Boudaoud N, Pons M, Bouche Pillon Persyn MA, Lefebvre F, Poli Merol ML, Francois C. Hypospadias. *Ann Chir Plast Esthet* 2016; 61(5):439-49.
39. Singh RB, Pavithran NM. Lessons learnt from Snodgrass tip urethroplasty: a study of 75 cases. *Pediatr Surg Int* 2004; 20:204–6.
40. Erlich RM. Tubularized-incised urethral plate urethroplasty: is regular dilatation necessary for success? *BJU Int* 2000; 86:145.
41. Bush NC, Snodgrass WT. The study by Shimotakahara et al evaluated urethral complications in patients undergoing tubularized incised plate (TIP) urethroplasty vs TIP with inlay grafting. *J Pediatr Surg* 2012; 47:1481.
42. Ritch CR, Murphy AM, Woldu SL, Reiley EA, Hensle TW. Overnight urethral stenting after tubularized incised plate urethroplasty for distal hypospadias. *Pediatr Surg Int* 2010; 26: 639-42.
43. Tavakkoli Tabassi K, Mohammadi Rana T. Tubularized incised plate urethroplasty using buccal mucosa graft for repair of penile hypospadias. *Urol J* 2012; 9:514-21.
44. Ye WJ, Ping P, Liu YD, Li Z, Huang YR. Single stage dorsal inlay buccal mucosal graft with tubularized incised urethral plate technique for hypospadias reoperations. *Asian J Androl* 2008; 10:682-6.
45. Khairallah M, Bader-Eldin M. Distal hypospadias repair with tubularized incised plate: Results, complications and management. *Menoufiya Med J* 2000; 12:146-50.
46. Al-Adl AM, El-Karamany TM, Bassiouny AS. Distal extension of the midline urethral-plate incision in the Snodgrass hypospadias repair: an objective assessment of the functional and cosmetic outcomes. *Arab J Urol* 2014; 12:116–26.

5/23/2017