

Modification of Snodgrass Technique for the Repair of Distal Hypospadias

MOHAMMED S.M. HASSAN, M.D.*; AMR I.F. ABDELFATTAH, M.D. and TAREK A. AMER, M.D.

The Department of Surgery, Faculty of Medicine, Cairo & Fayoum Universities.*

ABSTRACT

Surgical correction of hypospadias deformity has always challenges and perplexes surgeons. Although the functional improvement was the accepted goal of reconstruction, current operations strive to attain both functional and cosmetic aspects. The purpose of this prospective study was to present new modifications of Snodgrass technique for the treatment of distal hypospadias aiming at lowering the incidence of fistula formation. The study was performed between January 2006 and August 2008, the repair was performed upon 48 patients; including all of the distal varieties of Hypospadias and none of the cases had any previous operations for correction. Follow up of all cases (was done for 6-12 month) was performed concerning both functional and cosmetic aspects. The patients' age at time of repair ranged from 1 to 4 years, with a mean of 2.3 years. Complications include one case (2%) that developed fistula that necessitated re-operative repair, while another case developed a fistula that closed spontaneously with conservative approach. It was concluded that, the modifications prescribed for the tubularized incised plate urethroplasty relatively has a low incidence of complications with good outcome, both functionally and cosmetically.

INTRODUCTION

Hypospadias is the second most common congenital anomalies affecting the male external genitalia. It affects 1:300 male child births, 60% of such cases are of the distal variant [1]. Hypospadias is a result of incomplete formation of the urethra between the 10th and 14th weeks of gestational life. Surgery to repair hypospadias has a history of more than 150 years. To date, more than 300 surgical procedures with accompanying variations have been proposed for the repair of hypospadias. The appropriate repair should be as possible simple, easily learned, applicable to the majority of cases, completed in a single stage if possible and results in a pleasing cosmetic result with a low complication rate. No such repair has been described before [2].

Snodgrass [3] in 1994 redescribed the chordee tissue as embryonic mesenchymal tissue covered

with epithelium and preferred to name it as the "urethral plate". Instead of excising it, he preferred to use it for urethral reconstruction. He used this method for urethroplasty in glandular cases without chordee and later in distal, middle and even proximal cases with chordee [3,4,5].

In the tubularized incised plate repair; the entire urethral plate is incised in the midline from the hypospadiac meatus distally to the glans tip. This incision widens the plate, so that it can be tubularized to create a neo-urethra of normal caliber. Furthermore, the meatus is appropriately located at the tip of the glans and it is vertically oriented [2]. According to Snodgrass, [4,5] tubularized incised plate urethroplasty may be easily performed as a short and relatively bloodless procedure, especially in distal cases without chordee.

Snodgrass proposed that the incision into the urethral plate and glans open the large endothelial sinuses releasing epithelial growth factors, such as keratinocytic growth factor and encouraging tissue repair. Keratinocytic growth factor is known to stimulate the immediate repair of skin and urothelium after tissue injury. To address the concern of inadequate urethral plate width, Snodgrass introduced the concept of longitudinal midline incision of the urethral plate prior to tubularization. The deep incision does not compromise its viability and the dorsal surface re-epithelializes rapidly during the brief period of urinary diversion [3]. To minimize the risk of fistula formation, urethroplasty was then covered with a de-epithelialized preputial vascularized flap or if the patient is circumcised, a transverse island flap of subcutaneous tissue used [6].

PATIENTS AND METHODS

This prospective study included 48 patients with distal hypospadias who presented to Kasr

ElAini Hospital, Cairo University and Fayoum University Hospital during the period from January 2006 to August 2008. All the cases included were primary hypospadias cases, i.e. none of them had previously undergone a procedure for hypospadias repair.

A detailed history and a careful general examination were carried out for all patients. Local examination was done to define the following items:

- Shape of the glans penis.
- Presence of the prepuce (circumcised or not).
- Presence of chordee and/or rotation.
- Caliber and direction of urinary stream.
- The condition of nearby skin.
- Position and size of the meatus.
- Associated anomalies such as undescended testes, inguinal hernia and other congenital anomalies.

Routine laboratory investigations were done for all cases. Patients were admitted to the Hospital on the day of the operation, fasting was for 4-6 hours prior to operation.

Operative technique:

The suggested technique was as follows:

Following general anaesthesia, a traction suture of 5/0 silk was placed in the glans penis. A Nelton catheter 8-10 Fr was inserted in the urethra then passed a short distance into the bladder. A rubber tourniquet was applied to the base of the penis to achieve haemostasis. The tourniquet was left till urethroplasty was completed or for a maximum of 45 minutes. Parallel longitudinal incisions were made deep into the glans tissue from the urethral meatus to the tip of the glans, defining an intervening urethral plate measuring 6-8mm in width. This width may be increased up to 15mm, depending on the patient's age and penis size. A transverse incision proximal to the meatus was then marked and carried on. A longitudinal midline incision on the urethral plate from the dorsal aspect of the urethral meatus to the glans tip was marked, (Fig. 2). This incision was carried deeply, dividing all transverse webs and exposing the underlying corporal bodies. In order to avoid potential narrowing of the new urethra we extended the originally prescribed midline incision for few millimeters proximally into the normal urethra and distally to dorsal aspect of the tip of the penis in a meatotomy like fashion. An artificial erection test was done. If chordee was present, degloving of the penis was

done to cut cutaneous adhesions and thus to treat any cutaneous chordee. Then, artificial erection was repeated to ensure the absence of fibrous chordee. The incised urethral plate was tubularized (Fig. 3) essentially without tension over 8-10 Fr Nelton catheter. A larger catheter (12 Fr) was used in older patients (4 years) in whom a neourethra of larger luminal diameter is appropriate. Closure with an extramucosal continuous layer 6/0 polyglactin suture was used in all cases for neourethral closure. The distal extension of the midline incision assured adequate meatal caliber and decreases the risk for meatal stenosis and allow the neourethra to be closed till the distal end of urethral plate on the ventral aspect of the tip of the penis placing the neomeatus at the tip proper and avoiding the retrusion of the meatus.

A second layer of interrupted 6/0 polyglactin suture was used in all cases to invert the suture line and turning in any epithelial surface that may protrude between the suture of the first layer (Figs. 4,5). The neourethra was covered with a layer of subcutaneous tissue. In cases where degloving of the penis was done the dorsal prepuce was unfolded and the underlying dartos layer (Fig. 6) was sharply dissected to the base of the penis and then incised longitudinally in the midline. One side of the flap or alternatively in cases where no degloving of the penis was done, a dartos flap from the lateral penile shaft skin was then brought around to the ventral aspect of the penis and was secured over the neourethra with simple, interrupted, 6/0 polyglactin suture.

Adequate mobilization of the glans wings was assured such that their approximation over the neourethra was without tension with 5-0 polyglactin mattress suture. The skin of the glans was then closed with a fine absorbable suture using a vertical mattress or simple techniques (Fig. 7). Fashioning the meatus by simple interrupted suture approximation of the distal extent of the neourethra and the glans skin was avoided so as not to distort the meatal slit shape and minimize the risk of meatal stenosis.

Skin coverage of the ventral penile shaft was performed with mobilized ventral shaft skin. Patients had a gauze dressing wrapped around the penis. The Nelton catheter within the urethra was secured distally to the glans with a silk suture. The catheter was connected to a sterile urine bag. The time of operation was calculated from the time of application of tourniquet till closure of the glanular flap and shaft skin.



Fig. (1): Preoperative photo of a case of coronal hypospadias.

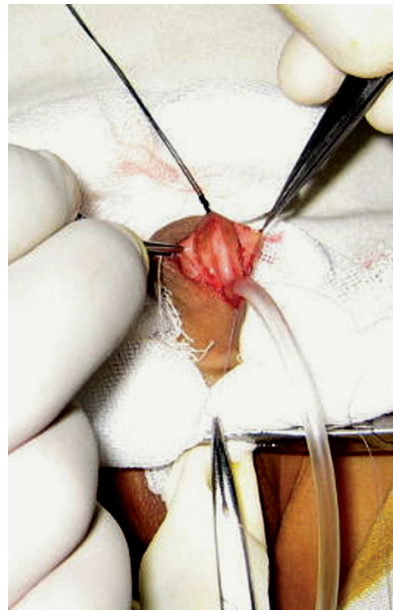


Fig. (2): The parallel and midline incision of the urethral plate with proximal and distal extensions.

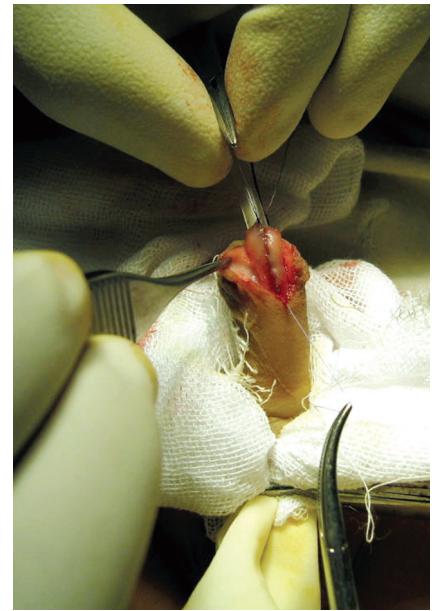


Fig. (3): 1st layer continuous suture of the neourethra.

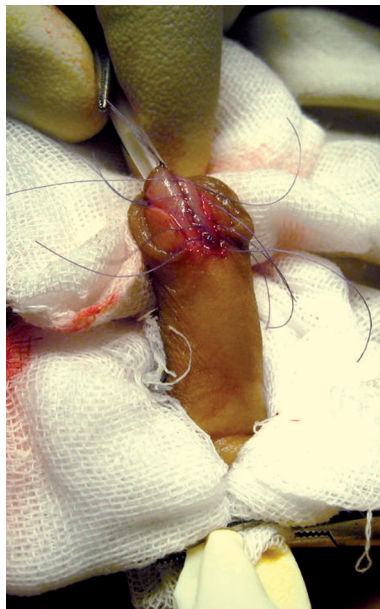


Fig. (4): Placement of the 2nd layer interrupted suture of the neourethra.



Fig. (5): Ligation of the 2nd layer interrupted suture of the neourethra.

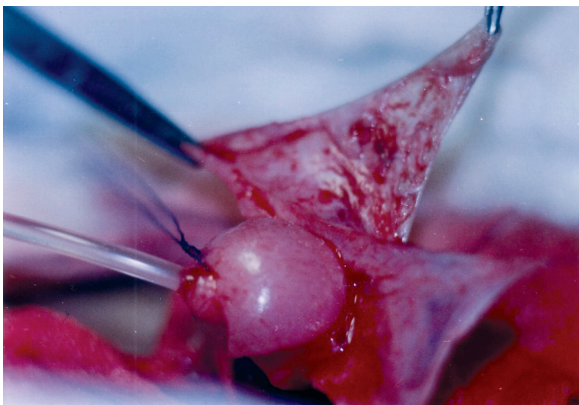


Fig. (6): Dissection of the preputial fascia and rotation to cover the neourethra.



Fig. (7): Closure of the glans penis.

Postoperative care and follow-up:

A broad spectrum antibiotics and analgesic were given and continued for few days after the operation. The patients were kept on a high fluid intake to prevent obstruction of the catheter. The dressing and the catheter were removed on the 4th day after the operation. Patients were discharged one week postoperatively. They were examined in the outpatient clinic every week during the first two months and every two weeks



Fig. (8): 4 days post operative photo showing the conical shape of the glans penis and the location of the meatus at the tip proper.



Fig. (9): 1 month post operative photo showing the slit shaped vertically oriented meatus at the tip proper of the glans penis.



Fig. (10): 6 months post operative while micturating showing the good caliber and natural direction and shape of the stream.

for four months (Figs. 8,9,10). The items of assessment included:

- a- Force and caliber of the urinary stream.
- b- Degree and duration of postoperative edema.
- c- Presence of complications e.g. infection, fistula or complete disruption of the repair.
- d- Evaluation of the late results postoperatively, by assessing the cosmetic appearance of the penis and meatus orientation or the late complications.

RESULTS

The study included 48 patients suffering from distal penile hypospadias. The age ranged between 1 and 4 years (mean age, 2.3 years). Seven cases (14.5%) had positive family history. Most of the cases had the meatus at the sub-coronal site (58%), 12 cases (25%) with anterior penile meatus and 8 cases (17%) with a glanular meatus (Table 1). Twenty four patients (50%) had minimal skin chordee that was released by degloving of the skin of the penis and no patients had a fibrous chordee. The operative time from the time of application of tourniquet to the last suture in the skin ranged between 45-70 minutes (mean, 63 minutes).

One patient (2%) developed reactionary haemorrhage. Compression was done for few minutes and succeeded to stop the bleeding. Post operative oedema was noticed in 2 cases (4%) and such cases improved few days later without any intervention. Urine retention was noticed in one patient (2%)

and relieved by 8 Fr catheter (the catheter was left for ten minutes). Two patients (4%) had mild infection that did not affect the final outcome of the repair. Meatal stenosis was noticed in 2 cases (4%) and such stenosis improved by periodic gradual urethral dilatation over few weeks. One case (2%) of less than thirty degree torsion occurred and necessitated no further intervention. Only one patient (2%) had a retrusive meatus however the stream of urine was forward in all cases. Urethrocutaneous fistula was noted in 2 cases (4%) one of them was associated with meatal stenosis and

closed spontaneously after regular dilatation, while the other case was successfully repaired after 6 months.

Table (1): Distribution of studied cases according to the type of hypospadias.

Site	Glanular	Subcoronal	Anterior penile	Total
No. of cases	28	8	12	48
Percentage	58	17	25	100

Table (2): Postoperative complications of the studied cases. (48 case).

Complication	Hemorrhage	Edema	Urine retention	Infection	Meatal stenosis	Penile torsion	Retrusive meatus	Fistula formation
No. of cases	1	2	1	2	2	1	1	1
Percentage	2	4	2	4	4	2	2	2

Table (3): Characteristics and overall results of the modified Snodgrass repair.

Result	No. of cases	Percentage (%)
<i>Type of hypospadias:</i>		
Glanular	8 cases	17
Subcoronal	28 cases	58
Anterior penile	12 cases	25
<i>Type of chordee:</i>		
Skin	24 cases	50
Fibrous	No cases	0
<i>Associated anomalies:</i>		
Undescended testis	1 case	2
Inguinal hernia	1 case	2
<i>Resultant meatal site:</i>		
Tip	47 cases	98
Retrusive	1 case	2
Breakdown	No cases	0
<i>Meatal orientation:</i>		
Vertical	47 cases	98
Torsion	1 case	2
Stenosis	2 cases	4
Fistula that necessitated repair	1 case	2
Operation time	45-70 minutes	

DISCUSSION

Hypospadias is a common congenital anomaly. The incidence of hypospadias has been calculated to be 3.2 per 1000 live male births or one in 300 [7]. More than two thirds of the cases of hyospa-

dias are in the distal shaft or the glans [8,9,10]. In this study, the site of hyospdiac meatus was glanular in 8 cases (20%), subcoronal in 22 cases (55%) and anterior penile in 10 cases (25%).

Undescended testis and inguinal hernia; are the anomalies that are most commonly associated with hypospadias [11]. In this study one case (2%) had inguinal hernia and one case (2%) had undescended testis in association with hypospadias.

Chordee is the abnormal ventral curvature of the penis, an entity that is poorly understood [11]. In this study it was found that 24 cases (50%) had chordee, all of cases had minimal skin chordee that was released by degloving of the skin of the penis.

Hypospadias continues to challenge today's constructive surgery just as it has since Thiercsh and Duplay reported the first contemporary repairs in the latter part of the nineteenth century [13]. Over 300 urethroplasties and their modifications have been described and new additions continually appear in the literature. Significant changes have marked the field during the past two decades; optical magnification and microsurgical techniques are important additions; most boys are operated on during the first year of life; preputial flaps are preferred over free grafts and one-stage procedures provide the standard for repair [14].

Many techniques had been described utilizing the urethral plate for correction of distal penile

hypospadias. The tubularized urethral plate urethroplasty extends the concept of hinging the urethral plate as a cosmetic modification of meatal-based and onlay-island flap techniques [15]. Simple urethral tubularization (Thiersch-Duplay, King, or GAP procedures) is attractive in its simplicity. However, the urethral plate is rarely wide enough to create an adequate urethral caliber. This may be compensated for by moving the longitudinal incisions lateral to the glanular ridges. But the resultant compromise in the glans wing closure combined with the overlying urethral and skin suture lines may account for the significant fistula rate [16].

Hinging the plate facilitates glans folding during glanuloplasty, extending the meatus to the tip of the penis, provides generous mobilization of the urethral plate for tubularization with or without additional skin flaps and helps create a cosmetically normal, centrally located, vertically oriented urethral meatus [17].

The functional results of distal hypospadias repair has been markedly improved in the last two decades. The reported complications rate is 5-10% [18]. As a result, the plastic surgeons are paying too much attention to improve the cosmetic results. Rich et al. [19] described the use of an incision in the glanular urethral plate to obtain a cosmetically acceptable slit-shaped meatus. Snodgrass subsequently adopted this approach along the entire length of the urethral plate as a complement to the Thiersch-Duplay urethroplasty [3]. The recently proposed algorithm to primary repair of distal hypospadias dictates using tubularized incised plate urethroplasty "Snodgrass" as a first choice [1,20].

To address the concern of inadequate urethral plate width, Snodgrass introduced the concept of longitudinal midline incision of the urethral plate prior to tubularization. The deep incision does not compromise its viability and the dorsal surface re-epithelializes rapidly during the brief period of urinary diversion. Snodgrass [3] proposed that the incision into the urethral plate and glans open the large endothelial sinuses releasing epithelial growth factors, such as keratinocytic growth factor and encouraging tissue repair. Keratinocytic growth factor is known to stimulate the immediate repair of skin and urothelium after tissue injury.

Midline glanular closure has been criticized for the theoretical increase risk of fistula formation with the overlying suture line [23]. To minimize the risk of fistula formation, urethroplasty was then covered with a de-epithelialized preputial

vascularized flap or if the patient is circumcised, a transverse island flap of subcutaneous tissue used [6].

The absence of the preputial skin in previously circumcised patients and inoperative cases makes TIP urethroplasty the ideal option. With this technique, additional skin flaps are not necessary for urethroplasty or for penile shaft skin coverage. Mobilized ventral penile shaft skin is usually sufficient for coverage. We applied this technique to patients with intact native urethral plate. Mild penile torsion was found in one case (2%). This might be explained with the wrap of the subcutaneous tissues to cover the neourethra and the midline suture line [21].

Hypospadias results from incomplete fusion of the urethral folds. The TIP repair demonstrates that the tissue that should have completed urethral development is largely preserved in the urethral plate. Midline incision widens the plate so that simple tubularization creates an adequate neourethra. Because this step essentially completes normal closure of the urethral folds, additional skin flaps are unnecessary and the meatus is properly located and vertically oriented [22].

An intact urethral plate enabled utilizing the technique for recurrent cases. The applicability and advantages of the TIP urethroplasty include the use of local, supple tissue with well-established vascularity for urethroplasty and skin coverage as well as the cosmetically superior result. The Snodgrass repair is ideal for repair following failed Mathieu, Onlay-island flap and tubularization procedures as; theoretically, the native vascularity of the urethral plate has not been altered [22].

Complications are common after hypospadias repair, ranging from fistulae to complete loss of the neourethra requiring total reconstruction [24]. Even in experienced hands, hypospadias repair is associated with the development of urethrocutaneous fistulae [25]. Fistula formation begins early in the healing process after ventral urethral repair. Incorporation of urethral mucosa in the ventral repair is a substrate for fistula formation with rapid migration of urethral mucosa and skin epithelium into suture tracts. The importance of a multi-layered repair and extra-mucosal suture technique are thus emphasized with respect to urethral repair [26]. The incidence of fistula is higher at the coronal sulcus 30-70% [27,28]. The coronal sulcus is a critical site for healing in urethral reconstruction; it is a relatively hypovascular transition bridge between the vasculature of the penile skin and that

of the glans. Dissection of penile skin and underneath the urethral plate at the coronal sulcus depletes the blood supply to the corona. Moreover, skin cover of the repair at the corona is usually fragile and then suturing may further compromise the blood supply to the edge of skin cover at the corona [29]. Failure of healing of the neourethra at the corona becomes more frequent when ischaemia is aggravated by the traction effect of penile erection soon after surgery, particularly in adolescent patients. When erection occurs, the traction tension is more prominent at the level of the corona, which is relatively a fixed point [28]. The small 'pinpoint' fistulae detected soon after repair are associated with distal obstruction and spontaneous closure occurs after neourethral dilatation [30]. Distal obstruction soon after repair leads to increased pressure inside the neourethra and extrusion of urine between the sutures. These fistulae represent dehiscence between sutures and thus healing may occur after re-stenting and/or postoperative dilatation. However, the truly epithelialized fistulous track never closes spontaneously and needs formal surgical repair [31]. Our reported experience of fistula formation was one case (2%) required surgical intervention for closure of the fistula. This compares favorably with other repairs and can be explained with the subcutaneous flap coverage that interpose the two suture line and minimize the fistula rate. In this work we modified the Snodgrass technique to minimize the incidence of fistula formation by extending the midline incision of the urethral plate for few millimeters proximally in the normal urethra and distally on the posterior aspect of the tip of penis. The proximal extension widens the urethra at the coronal site allowing tension free repair at this common site of fistula formation. The distal extension of the midline incision to the few millimeter to the dorsal aspect of the tip of the penis allow the closure of the neourethra till its end and preventing retrusive meatus and make the new meatus of good caliber and properly placed at the tip and minimize meatal stenosis and distal obstruction. We also added the second layer of interrupted suture to invert and turn in the suture line to avoid any protruding epithelial or mucosal surface between the suture line and minimizing the possibility of epithelialized tracks.

Postoperative follow-up of our studied cases revealed urethral stenosis in 2 cases (4%) that improved over a period of 2-3 months, using periodic neourethral calibration. Snodgrass [22] evaluated 72 patients operated upon using the TIP technique postoperatively using cystoscopic uroflowmetry, revealed that dorsal relaxing incision

of the plate does not result in stricture formation. With this technique only one suture line is necessary, saving operating time and decreasing the possible risk of urethrocutaneous fistula. In addition, with the dorsal urethral incision it is possible to create a vertical meatus of natural appearance. Other recent studies indicate that the Snodgrass procedure causes fewer complications, especially fistulae [6,17].

Conclusion:

There is no single, universally applicable technique for hypospadias repair. The present study presented a new modification of the Snodgrass technique which is feasible, safe with relatively low complication rate and good functional and cosmetic outcome. Long term results of this new modification are awaited for better evaluation by uroflowmetry, voiding urethrography and urethroscopy which we are now performing in another concurrent study.

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