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Randomized Comparative Study between Mathieu Flip-Flap and Snodgrass Techniques for the Repair of Distal Hypospadias

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ABSTRACT

Hypospadias is a common congenital anomaly, with the majority of cases are of the distal variety. Surgical correction of hypospadias deformity has challenged and perplexed surgeons. Although the functional improvement was the accepted goal of reconstruction, current operations strive to attain normal functional and cosmetic aspects. The purpose of this prospective study was to determine whether the perimeatal based flap (Mathieu); or the tubularized incised plate urethroplsty (Snodgrass) technique is more appropriate for treatment of distal hypospadias. This is achieved by comparing both techniques as regards complications rate and cosmetic aspect. From September 2001 to April 2002 the repair was performed upon 40 patients; 20 patients were allocated to undergo a Mathieu repair and 20 patients were allocated to undergo a Snodgrass repair randomly. Both groups were compared as regard functional and cosmetic aspects. The patient age at the repair ranged from 12 months to 15 years, with a mean of 3 years. Only one case developed fistula that necessitated re-operative repair, and two cases developed fistula that closed spontaneously in the Snodgrass repair; while four cases developed fistula and all necessitated re-operative repair in the Mathieu repair. The study has concluded that tubularized incised plate urethroplasty takes less time and relatively of low incidence of complications and better cosmetic aspect than Mathieu repair.

INTRODUCTION

Hypospadias is a result of incomplete formation of the urethra during the 10th to the l4th 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. Such repair should be simple, easily learned, applicable to the majority of cases, completed in a single stage and resulting in pleasing cosmetic result with a low complication rate. No such repair has been described to date [1].

A number of surgical procedures have been described using the urethral plate to correct distal shaft and coronal hypospadias. The glans approximation procedure involves simple tubularization of the urethral plate to correct the coronal meatus with a deep glanular cleft [2]. Similarly, the pyramid repair described for the unusual megameatus with intact prepuce also includes tubularization of the deeply grooved urethral plate [3].

In most of the cases, the ventral glans does not have a deep groove and simple tubularization of the urethral plate would not provide an adequate diameter for the neourethra. The meatal based (Mathieu) flip-flap and onlay island preputial flap repairs are then popularly used to supplement the urethral plate with ventral shaft or preputial skin, respectively. A criticism of these repairs is that the resultant meatus is horizontally oriented and round, which while functional, is cosmetically less desirable than the normal, vertically oriented, slit like meatus [4].

In 1994, Snodgrass presented a new procedure to correct such defects by tubularization of the urethral plate without using additional flaps. In 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 neourethra of normal caliber. Furthermore, the meatus is appropriately located at the tip of the glans and it is vertically oriented [1].

The aim of this study was to compare the commonly used Mathieu Flip-Flap technique with the relatively new Snodgrass technique in the repair of distal hypospadias.

PATIENTS AND METHODS

This prospective study included 40 patients with distal hypospadias who presented to Kasr El-Aini Hospital, Cairo University and its Fayoum branch during the period from September 2001 to April 2002. All the cases were chosen primary hypospadias cases i.e. none of them had previously undergone a procedure for hypospadias.

The patients were divided randomly into two groups of twenty patients each. One group was allocated to undergo a Mathieu repair and the other group a Snodgrass procedure. The same team repaired and assessed all cases.

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

- Shape of the glans.
- Presence of the prepuce.
- Presence of chordee 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.

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

Operative technique:

Patients were randomly selected for either Mathieu or Snodgrass technique. The number of cases was equal in both groups.

In the Mathieu group the technique was as follows:

Following general anaesthesia, a traction suture of 5/0 silk was placed in the glans penis. A silastic catheter 8-10Fr. 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 45 minutes maximum.

Parallel longitudinal incisions were made deep into the glans tissue from the urethral meatus to the tip of the glans, to define an intervening urethral plate measuring 6-8mm in width. This width may be increased up to 15mm, depending on the patient's age and phallic size. A skin flap was outlined proximal to the meatus, long enough to reach the tip of the glans (Fig. 1,B).

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. If chordee persisted, it was diagnosed as fibrous chordee which was treated in this group by dorsal plication of the tunica albuginea.

The meatal-based flap was then dissected by blunt scissor from the underlying urethra (Fig. 1,C). Extreme care was taken to avoid damage of the vascular pedicle of the flap as dissection approach the subcutaneous tissues adjacent to the meatus.

The flap was then "flipped" distally and sutured to the edges of the urethral plate using a double layer 6/0 polygalactin running suture on each side (Fig. 1,D). The tourniquet was then removed and bipolar diathermy was used to control bleeding. The lateral wings of the glans were mobilized and closed by a simple or vertical mattress suture. Skin coverage of the ventral penile shaft was performed with either rotational flaps of dorsal skin or mobilized ventral shaft skin if sufficient.

The silastic catheter within the urethra was secured distally to the glans with prolene suture. The catheter was connected to a urine bag. Patients had a gauze dressing, rapped around the penis.

The time of operation was calculated from the time of application of tourniquet till closure of the glanular flap and shaft skin.

In the Snodgrass group, the technique was as follows:

Following general anaesthesia, a traction suture of 5/0 silk was placed in the glans penis. A silastic catheter 8-10Fr. 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 45 minutes maximum.

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 phallic size. A transverse incision proximal to the meatus was then marked and carried circumferentially to incorporate mucosal cuffs, but it is otherwise in closer proximity and parallel to the corona.

A longitudinal midline incision on the urethral plate from the dorsal aspect of the urethral meatus to the glans tip was marked (Fig. 2,B). This incision

was carried deeply, dividing all transverse webs and exposing the underlying corporal bodies.

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. If chordee persisted, i.e. fibrous chordee, correction was achieved by excision of the fibrous band through the longitudinal midline incision.

The incised urethral plate was tubularized (Fig. 2,C) without tension over 8-10Fr. silastic catheter. A larger catheter may be used in older patients in whom a neourethra of larger luminal diameter is appropriate.

Closure with a continuous single layer 6/0 polyglactin suture was used in all cases for neourethral closure. The neourethra must not be closed too tightly at its distal extend. This assures adequate meatal caliber and decreases the risk for meatal stenosis.

The neourethra was covered with a layer of subcutaneous tissue. The dorsal prepuce was unfolded and the underlying dartos layer was sharply dissected to the base of the penis and then incised longitudinally in the midline. One side of the flap or alternatively, 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. 2,D), and the meatus was fashioned by simple interrupted suture approximation of the distal extent of the neourethra and the glans skin.

Skin coverage of the ventral penile shaft was performed with either rotational flaps of dorsal skin or mobilized ventral shaft skin if sufficient (Fig. 2,D). Patients had a gauze dressing, rapped around the penis.

The silastic catheter within the urethra was secured distally to the glans with prolene suture. The catheter was connected to a urine bag.

The time of operation was calculated from the time of application of tourniquet till closure of the glanular flap and shaft skin.

Postoperative care and follow-up: A broad spectrum antibiotics and analgesic were given, for few days after the operation. The patient is kept on high fluid intake to prevent obstruction of the catheter.

The dressing was 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 for four months. 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 or the late complications.

RESULTS

The study included 40 patients suffering from distal penile hypospadias. Their ages ranged between 1 and 15 years (mean age, 3 years). Six cases (15%) had positive family history.

Most of the cases had the meatus at the subcoronal site (55%), 10 cases (25%) with anterior penile meatus and 8 cases (20%) with a glanular meatus (Table 1). Twenty patients (50%) had minimal skin chordee that was released by degloving of the skin of the penis and only four patients (10%) had a fibrous chordee to whom dorsal plication was done to two cases and excision of the fibrous band was done to two cases (Table 2).

The operative time from the time of application of tourniquet to the last suture in the skin ranged between 75-90 minutes (mean, 82 minutes) in the Mathieu group and 45-70 minutes (mean, 63 minutes) in the Snodgrass group (Table 3).

Two patients, one of each group, developed reactionary haemorrhage. Compression for few minutes could stop the bleeding.

Post operative oedema was noticed in 6 patients (30%) in Mathieu group compared to 2 cases (10%) in Snodgrass group. All cases improved few days later. Urine retention was noticed in two patients (one of each group) and relieved by 8Fr. catheter (the catheter was left for ten minutes).

Three patients of Mathieu group developed partial wound infection, one patient had severe infection that resulted in wound dehiscence and complete

breakdown of the repair. Culture revealed staphylococcal organism, and the other patients had mild infection that did not affect the repair. Two patients of the Snodgrass group had mild infection that did not affect the repair.

Meatal stenosis was noticed in 6 cases of Mathieu group compared to 4 cases of the Snodgrass group. The stenosis improved by periodic gradual urethral dilatation over few weeks.

There was no penile torsion in the Mathieu group. One case of less than thirty degree torsion occurred in the Snodgrass group and necessitated no further intervention.

Two patients of the Mathieu group had a retrusive meatus compared with only one patient of the Snodgrass group. The stream of urine was forward in both groups.

Urethrocutaneous fistula was noted in 4 cases (20%) of the Mathieu group including 2 of them were associated with meatal stenosis and were successfully repaired later. This is compared with 3 cases of the Snodgrass group two cases of them were associated with stenosis and closed spontaneously while one case was successfully repaired later. Table (4) illustrates the complications encountered in both groups.

The overall results of both groups are illustrated in Table (5). Figs. (1,2) show preoperative, operative and postoperative results in some of the studied cases.

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

Site	Glanular	Subcoronal	Anterior penile	Total
No. of cases	8	22	10	40
Percentage	20	55	25	100

Table (2): Incidence of chordee among the studied cases (24 cases).

Type of chordee	Cutaneous	Fibrous	Total
No. of cases	20	4	24
Percentage	50	10	60

Table (3): Operative time in both groups.

Operation	Mathieu	Snodgrass
Time	75-90 minute	45-70 minute

Table (4): Postoperative complications of the studied cases.

Complication	Mathieu (Total 20)	Snodgrass (Total 20)
Hemorrhage	1 (5%)	1 (5%)
Edema	6 (30%)	2 (10%)
Urine retention	1 (5%)	1 (5%)
Infection	3 (15%)	2 (10%)
Meatal stenosis	6 (30%)	4 (20%)
Penile torsion	0	1 (5%)
Retrusive meatus	2 (10%)	1 (5%)
Wound dehiscence	1 (5%)	1 (5%)
Fistula formation	4 (20%)	1 (5%)

Table (5): Characteristics and overall results of the Mathieu and the Snodgrass repair.

	Mathieu	Snodgrass
Type of hypospadias:		
Glanular	4 Cases (20%)	4 Cases (20%)
Subcoronal	11 Cases (55%)	11 Cases (55%)
Anterior penile	5 Cases (25%)	5 Cases (25%)
Chordee:		
Skin	11 Cases (55%)	9 Cases (45%)
Fibrous	2 Cases (10%)	2 Cases (10%)
Associated anomalies:		
Undescended testis	1 Case (5%)	1 Case (5%)
Inguinal hernia	1 Case (5%)	1 Case (5%)
Resultant meatal site:		
Tip	17 Cases (85%)	19 Cases (95%)
Retrusive	2 Cases (10%)	1 Case (5%)
Breakdown	1 Case (5%)	No cases
Meatal orientation	Rounded 16 cases (70%) Transverse 4 cases (30%)	Vertical 19 cases (95%) Torsion 1 case (5%)
Stenosis	6 Cases (30%)	4 Cases (20%)
Fistula	4 Cases (20%)	1 Case (5%)
Operation time	75-90 minutes	45-70 minutes

Fig. (1-A): Preoperative view of a case of coronal hypospadias.

Fig. (1-B): Design of the Mathieu flip-flap.

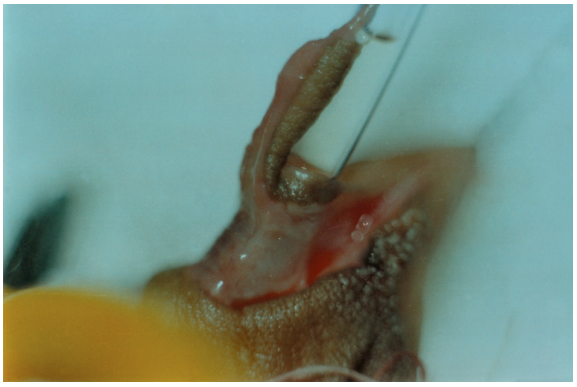

Fig. (1-C): The meatal based flap is elevated.

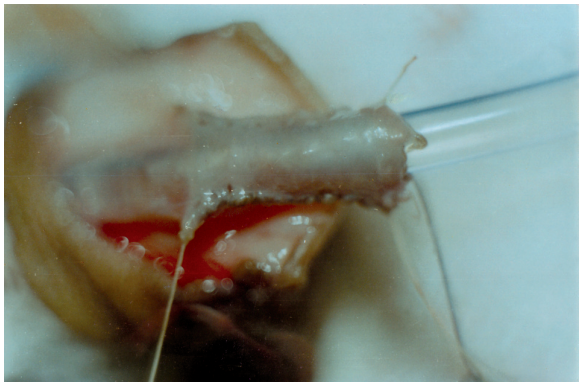

Fig. (1-D): Urethroplasty completed.

Fig. (1-E): Postoperative view showing the rounded meatus after Mathieu flip flap.

Fig. (1-F): Postoperative photograph of same patient while micturating.

Fig. (2-A): Preoperative view of a case of subcoronal hypospadias.

Fig. (2-B): Marking of incisions of Snodgrass technique.

Fig. (2-C): After closure of the urethroplasty.

Fig. (2-D): After closure of glans and ventral shaft skin defect.

Fig. (2-E): Postoperative view showing the slit shaped meatus.

Fig. (2-F): Postoperative photograph of same patient while micturating.

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 **[5]**.

More than two thirds of the cases of hypospadias are in the distal shaft or the glans **[3,6,7]**. In this study, the site of hypospdiac 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. In one series, 9.3% of patients with hypospadias had an undescended testis **[8]**. In this study 2 cases (5%) had inguinal hernia and 2 cases

(5%) had undescended testis in association with hypospadias.

Chordee is the abnormal ventral curvature of the penis, an entity that is poorly understood **[9]**. In this study it was found that 24 cases (60%) had chordee. The majority of cases (20 patients) had minimal skin chordee that was released by degloving of the skin of the penis. Only four patients had fibrous chordee to whom dorsal plication was done to two cases and excision of the fibrous band was done to two cases.

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 **[10]**.

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 **[11]**.

Many techniques had been described utilizing the urethral plate for correction of distal penile hypospadias. The tubularized urethral plate urethroplasaty extends the concept of hinging the urethral plate as a cosmetic modification of meatal-based and onlay-island flap techniques **[12]**.

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 **[13]**.

The MAGPI operation is best limited to the small, pliable subcoronal or glanular meatus with a flat glans, it may results in distortion of the glans and a round, rather than elliptical meatus. Even its advocates warn that the MAGPI must be avoided in patients with excessively thin or rigid ventral parameatal skin, or a meatus that is too wide or too proximal **[14]**.

The meatal-based flap (Mathieu) is a reliable method for correcting distal hypospadias with a low fistula rate. It is used for non-compliant meatus associated with a flat glans. However, it often results in an anchor-shaped meatus with a transversely oriented proximal lip **[15]**.

The onlay island-flap repair is a method that is technically more challenging and associated with meatal stenosis relative to other urethroplasty. On the basis of tissue availability alone, the onlay island flap is rarely feasible option in previously circumcised patients or reoperative cases **[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]**.

Snodgrass **[4]** 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.

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 **[18]**.

Midline glanular closure has been criticized for the theoretical increase risk of fistula formation with the overlying suture line. Our reported experience of fistula formation is 20% (four cases) of the Mathieu group that required surgical intervention while only 5% (one case) of the Snodgrass group 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 **[19]**.

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 **[20]**.

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 (5%) of the Snodgrass group and no cases of Mathieu group. 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 **[20]**.

Complications are common after hypospadias repair, ranging from fistulae to complete loss of the neourethra requiring total reconstruction **[22]**. Even in experienced hands, hypospadias repair is associated with the development of urethrocutaneous fistulae. The meatal-based flap urethroplasty is commonly used for the primary correction of distal hypospadias. However, the two suture lines necessary for the flap increase the risk of developing a coronal urethrocutaneous fistula. There is also an increased risk of meatal stenosis because the blood flow in the distal part of the flap is reduced **[23]**.

Postoperative follow-up of our studied cases revealed urethral stenosis in 30% (six cases) of Mathieu group this can be explained with diminished vascularity of the tip of the flap and 20% (four cases) of Snodgrass group that improved over a period of 2-3 months, using periodic neourethral calibration. Snodgrass **[20]** 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 a urethrocutaneous fistula, which is proved in this work. 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 than the Mathieu repair, especially fistulae **[17,18]**.

Conclusion:

There is no single, universally applicable technique for hypospadias repair. The present study confirms the relatively lower complication rate of the Snodgrass repair. The Snodgrass procedure was significantly faster than the Mathieu repair and the cosmetic appearance of the neomeatus was more natural. Long term results of this new technique are awaited for better evaluation.

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