Egypt, J. Plast. Reconstr. Surg., Vol. 34, No. 1, January: 43-48, 2010

The Use of Vascularized Urethra in Management of Crippled Hypospadias

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ABSTRACT

Urethral reconstruction following multiple failed hypospadias repair is a challenging problem for the reconstructive surgeon. This is due to the paucity of healthy, well-vascularized tissues and extensive scarring of ventral penile skin from multiple previous surgical procedures. The aim of this paper is to reintroduce and elaborate on the technique of using the free radial forearm flap in reconstruction of crippled hypospadias. In this paper five patients with crippled hypospadias and were having long urethral defects were operated upon using the free radial forearm fasciocutaneous flap for reconstruction of both urethral tube and its overlying ventral skin cover. The flaps survived completely without complications and the patients were able to void normally from their penile tip with strong urinary stream.

INTRODUCTION

Reconstruction of urethra following repeated failure of hypospadias repair is still considered as a reconstructive challenge. This is mainly due to the deficiency of healthy and well-vascularized local tissues. Crippled hypospadias patients usually suffer from many problems. Sometimes they have a missing segment of the urethra or even the whole urethra may be absent. Multiple urethral fistulae with extensive scarring of ventral penile skin are usually present due to multiple surgical procedures. They suffer also from small penile size with penile curvature as if the chordee re-developed again **[1]**.

The principle of reconstruction of hypospadias is to bring well vascularized skin flaps from the prepuce, penile shaft, or scrotum **[2-4]** and for long urethral defects full-thickness free skin grafts is the ideal choice **[5]**. Despite of technical improvements and newer techniques, urethral crippled hypospadias is still seen **[6,7]**. The penis in these patients is extensively scarred and relatively avascular, due to multiple undergone surgeries. Local flaps are no longer available, prepuce has been employed before and the scrotal skin usually has been repeatedly used in trials for reconstruction and unsuitable for introduction of new tissue to the penile shaft. The patients with crippled hypospadias usually suffer from severe scarring, fistulas, strictures and even diverticulae together with shortage in their ventral penile skin due to repeated multiple surgical procedures.

The two goals aimed in urethral reconstruction are formation of well vascularized urethral tube and its coverage by a well vascularized ventral skin. In crippled hypospadias patients, this could be only achieved by borrowing vascular tissue from far area. Harrison **[1]** was the first one to introduce the technique of using the free radial forearm flap in treatment of crippled hypospadias patients. His work was based on the idea of one stage reconstruction of penis in cases of surgical amputation and congenital penile absence, yet the flap was used only to reconstruct the whole urethra and the overlying skin cover. Total penile with urethral tube reconstruction has been described by Chang and Hwang **[8]**. Morrison et al. **[9]** employed the free radial forearm flap in reconstruction of scarred urethra in four patients with crippled hypospadias. Lou et al. **[10]** used the radial forearm flap to reconstruct only the urethral tube in one case. Later on few sporadic case reports on the use of the radial forearm flap in isolated urethral tube reconstruction due to infection or as a part of phallic reconstruction **[11-16]** were published. Santanelli **[12]** used the radial forearm flap in one case to reconstruct the glans and urethral tube and the flaps were very easily accommodated within the penile shaft. Another modification of the radial forearm flap in total phalloplasty was the "cricket bat" design described by Semple et al. **[13]**. Yong et al. employed a prefabricated neo-urethra within the radial forearm flap in one case to compensate for urethral loss after total lateral arm phalloplasty **[14]**. Shcheplev et al., used radial forearm flap as

vascularized urethra (in seven cases), in 2 of them associated phalloplasty with thoracodorsal flap **[16]**.

In crippled hypospadias patients, any attempt of using the local tissues for further urethral reconstruction is doomed to failure. Utilizing well vascularized tissue borrowed from far may be the only method to overcome this problem. Although the technique of using the radial forearm flap in total phalloplasty and isolated urethral reconstruction is well known and commonly used. However, its use in simultaneous urethral reconstruction and providing stable ventral skin cover is not commonly practiced. The aim of this article is reintroduce and elaborate on the technique of using the radial forearm flap for one stage reconstruction of the urethral defect and the overlying ventral penile skin in crippled hypospadias patients.

PATIENTS AND METHODS

The study was conducted in the department of plastic surgery of Ain Shams University hospitals from December 2003 to September 2006 with follow up of an average 16 months. It included 5 patients with crippled hypospadias. Their ages ranged from 23 to 31 years. Each of them had undergone at least from 10 to 13 unsuccessful surgeries for hypospadias repair. All of them were psychologically depressed, non self confident and worried about their ability of getting married and having children. All of them had multiple scars of the supra pubic urinary diversion and inguinal donor site scarring due to previous harvest of full thickness skin grafts.

Anatomical deformity was found in all patients in the form of small sized penis, multiple scars along the ventral aspect of the shaft of the penis together with scrotal scarring and fibrosis as a result of using scrotal skin in reconstructive trials

In 4 patients the whole length of the urethra was missing and the urethral opening was identified at the penoscrotal junction. In one patient the urethral opening was covered by a band of contracture and scarring from the used scrotal skin. The fifth patient had a urethral opening distally but there were multiple fistulae long the urethral length. The biggest one was located at the proximal penile shaft with some hair coming through it.

The surgery was performed by two teams who worked simultaneously. Urinary diversion was done at the beginning through supra-pubic cystostomy. The first team prepared the receiving bed and recipient vessels. The whole scarred ventral penile skin was removed including the chordee if it is present and full release of the penile contracture was done. In one patient a dorsal penile contracture had to be released firstly and reconstructed by split thickness skin graft to achieve the desired penile length before further urethral and ventral penile skin reconstruction. A dermal graft was required in two patients to resurface a missing part of the tunica albuginia covering the penile corpora after full penile release Then ruminants of old urethra and fistulae were resected until totally normal tissue was identified, mobilized and prepared for anastomosis to the neourethral skin tube. Artificial erection test was performed to be sure about full penile release and to assess the accurate length of the urethral defect to be reconstructed (Fig. 1-A).

The deep inferior epigastric vascular pedicle was chosen as the first choice recipient vessel because of good size match with radial forearm flap vessels. It was exposed by a longitudinal incision in the groin extending from above the inguinal ligament to the upper part of the thigh. The external oblique muscle and conjoint tendon are split in the line of their fibers where the inferior epigastric vessels are located in the extra-peritoneal plane just lateral to the lateral margin of the rectus abdominis muscle. They are followed superiorly as they ascend deep to the lateral aspect of the rectus abdominis. Here they are divided elevated and reflected downwards into the wound. Through the same incision one of the major tributaries of the great saphenous vein is identified and divided distally and reflected up to the inguinal region. A subcutaneous tunnel is made from this incision to the base of the penile wound to permit passage of the radial vessels of the radial forearm flap. If the deep inferior epigastric vessels were not suitable, the anastomosis was done with one of the branches of the femoral artery in the upper part of the thigh and occured only in one case.

The radial forearm flap with appropriate dimensions was designed on the most hairless part of the distal forearm skin. It was raised at the same time from the contralateral forearm after doing Allans test. The width of the skin paddle of the reconstructed urethra ranged from 3 to 4cm. The whole width of the flap was 10cm and the length of the flap ranged from 13 to 16cm according to the penile length in each patient (Fig. 1-B). The urethral paddle was tubularized watertight around a 16 Fr balloon catheter in its centre. The lateral paddles were approximated in the midline to close a second layer over the neourethral tube and to become the new ventral skin of the penis (Fig. 1-C,D). A two cm cuff of the radial forearm fascia was included

on each side of the skin paddle and it was tucked under the lateral and dorsal penile skin flaps for augmentation of the penile girth (Diagram 1). The flap included the maximum pedicle length of the radial artery and its venae comitantes. The cephalic vein was also included in the flap to allow performing two venous anastomoses. The tip of the catheter is then introduced in the bladder through the perineal urethra. The proximal end of the neourethra was then sutured to the urethral stump. The other end of the flap was sutured to the glans to establish urethral continuity.

Microvascular repair was then performed. The radial artery and one of its venae comitantes were anastomosed with the deep inferior epigastric artery and vein or external pudendal artery and vein both by an end-to-end anastomosis (Fig. 1-E,F). A second venous anastomosis was done between the cephalic vein of the flap and one of the great saphenous vein tributaries. Finally, the donor site was reconstructed by STSG. All the patients received only a single dose of heparin according to the body weight before the release of the arterial clamp.

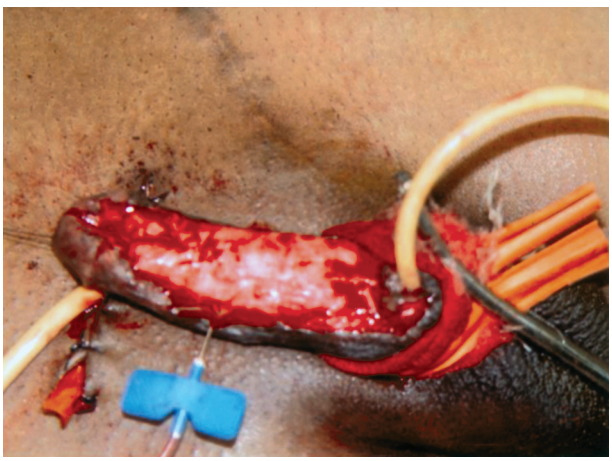

Fig. (1-A): Artificial erection to assess the exact length of urethra needed.

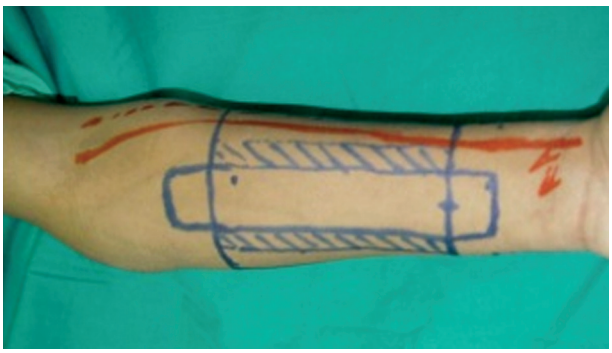

Fig. (1-B): Design of neourethra on the radial forearm flap.

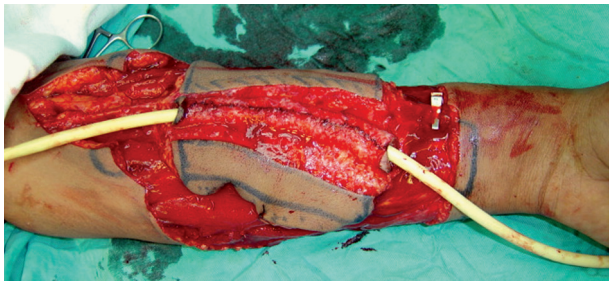

Fig. (1-C): The flap after elevation and tubing on the F16 catheter.

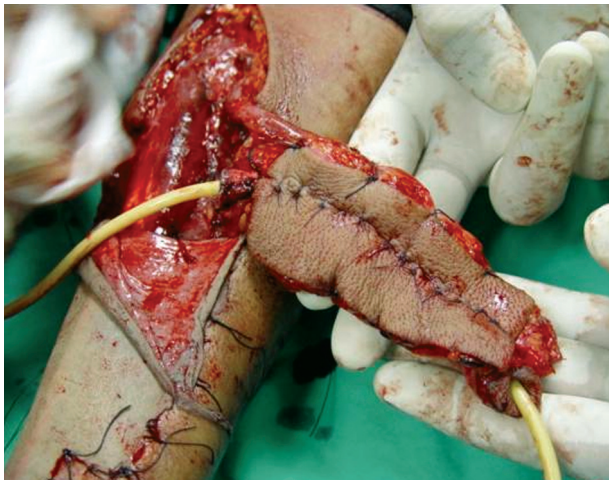

Fig. (1-D): The flap after of the second skin layer on the urethra.

Fig. (1-E): Inset of the flap and microvascular anastomosis with deep inferior epigastric vessels and tributary of the great saphenous vein.

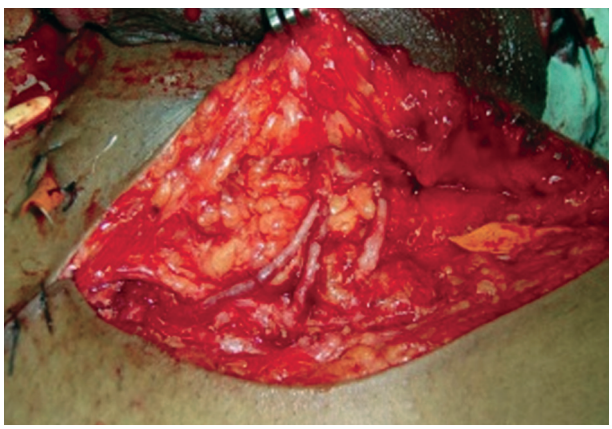

Fig. (1-F): Close up of the microvascular anastomosis.

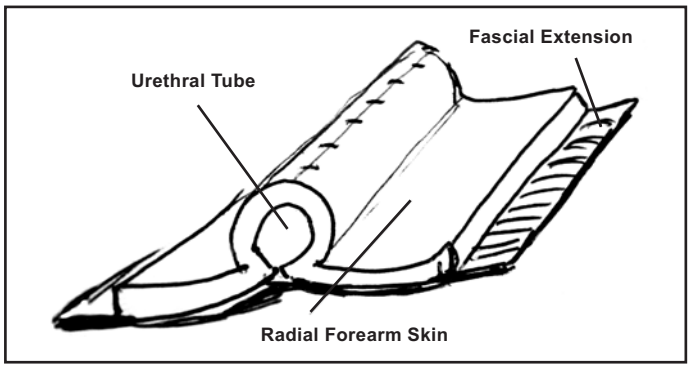

Diagram (1): A 2cm cuff of forearm fascia is included in the flap to increase the girth of the penis.

Fig. (2-A): Absent distal urethral tube with penoscrotal hypospadias, notice scarring of the whole ventral penile skin.

Fig. (2-B): Flap after healing with good cover.

Fig. (3-A): Severe dorsal penile scarring and shortening.

Fig. (3-B): Released dorsal penile scarring with applied STSG.

Fig. (3-C): Severe ventral penile contracture covering proximal penile hypospadias with crumpled scrotal skin.

Fig. (3-D): Applied free vascularized urethra with good ventral penile skin release.

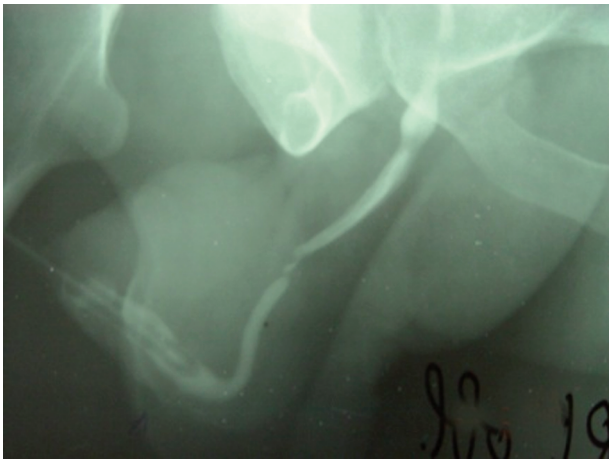

Fig. (4-A): Urethrogagpy showing stricture at the site of proximal urethral anastomosis.

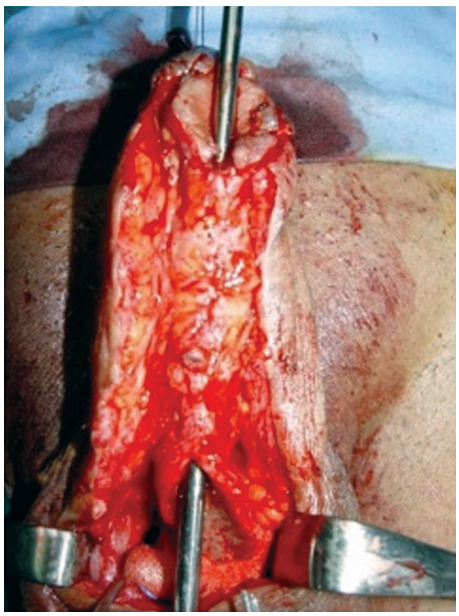

Fig. (4-B): Pin hole mid penile fistula and revision of proximal urethral anastomosis and meatal advancement.

Fig. (5): Donor forearm covered by STSG.

RESULTS

Good results in the form of complete survival of all the flaps were obtained with good healing, without any fistula formation. As regards functional results, all the patients had good strong urine stream from the penile tip (Figs. 2,3). Only one patient had asymptomatic tiny fistula at the mid penile shaft, with difficulty in urinary dilatation. The distal urethral end was also proximally recessed. His ascending urethrography (Fig. 4-A) showed the presence of passable stricture at the site of the proximal anastomosis with minimal post-stricture dilatation. This patient was explored where excision of the fistula, resection of the stricture and redo of the proximal urethral anastomosis in a V-Y manner (Fig. 4-B). At the same session further meatal advancement and debulking half the flap was done. The donor sites skin grafts totally healed (Fig. 5).

Aesthetically the flap was bulky and every patient needed at least two sessions of debulking. Each time one half of the flap was debulked. The most noticeable was much improvement of the penile size. The donor site skin grafts totally healed with accepted aesthetic results.

DISCUSSION

Reconstruction of urethra following repeated failure of hypospadias repair is still considered a reconstructive challenge. The principle of reconstruction of hypospadias is to bring well vascularized skin flaps from the prepuce, penile shaft, or scrotum **[2-4]** and for long urethral defects full-thickness free skin grafts is the ideal choice **[5]**. Despite of technical improvements and newer techniques, urethral crippled hypospadias is still seen **[6,7]**. The penis in these patients is extensively scarred and relatively avascular, due to multiple undergone surgeries. Extra-genital skin, bladder, buccal mucosa, local flaps, prepuce and scrotal skin have been employed repeatedly in reconstruction trials. Crippled hypospadias patients usually suffer from many problems, as multiple fistulae, missing segment or whole absence of the urethra. Extensive scarring of ventral penile skin due multiple failed surgical procedures usually results in penile curvature **[1]**. Due to the relative local ischemia and deficiency of healthy and well-vascularized local tissues, every attempt of reconstruction by using local flaps increases the chances of failure. The idea of using of a well vascularised tissue from a far area is not new. It was introduced by Harrison, in 1986 **[1]** where he used the free radial forearm flap as one-stage reconstruction of neourethra and its overlying skin cover in two cases of crippled hypospadias.

In this paper we utilized the same technique in management of crippled hypospadias patients. In the present article all the patients have already undergone from 10 to 13 unsuccessful surgeries for hypospadias repair. The bad quality, scarring and ischemia of the ventral penile skin cannot withstand any further reconstruction by local

tissues. For this reason simultaneous urethral reconstruction with providing the overlying skin cover was mandatory. This may explain why other authors reconstructed the urethra only without the skin overlying it **[9,10]** as in their cases the ventral skin condition was much better than in our cases.

Selection of the free radial forearm flap was the most suitable choice for urethral reconstruction as it is a thin, non hairy flap with reliable vascularity. It has long pedicle that facilitates microvascular anastomosis **[9]**. Inclusion of a cuff of the radial forearm fascia in the flap and was used to augment the penis laterally because these patients usually have small penile size due to multiple previous surgical interventions.

Unlike other authors who performed end to side anastomosis with the femoral vessels as recipient vessels **[1,11]** we used end to end anastomosis with the deep inferior epigastric or the external pudendal vessels. This omits the need for vein grafts or venous loops which are usually associated with increased incidence of microvascular complications. At the same time this will avoid putting the limb vascularity at risk.

As regards the advantages of this technique, the availability of enough amounts of thin non hairy well vascularized skin can permit excision of any fibrosis and scar tissues on the ventral surface of the penis wherever its level. This will allow full release of the scarred penile ventral surface and in turn will further elongate the penile shaft. This big amount of tissues allows simultaneous reconstruction of both the urethral tube and its overlying skin cover whatever its length. Being well vascularised tissue, there is nearly no incidence of fistula. An important advantage of this technique is the adding of more bulk to the already hypoplastic penis by the use of fascial extensions on either sides of the flap. The long vascular pedicle of the flap facilitates anastomosis with inferior epigastric vessels without need of vein grafts. Aesthetically, the use of the radial artery free flap in urethral surgery is excellent.

Its disadvantages include the sophisticated procedure and the need for both microvascular technique and instruments. It requires more than one stage for debulking and refashioning of the flap. Sacrificing of a major blood vessel in the upper limb and donor site morbidity in the forearm are other disadvantages of this technique.

Conclusion:

The use of vascularized urethra in management of crippled hypospadias may be sometimes the only successful method for correction of this difficult deformity. It allows simultaneous reconstruction of the whole urethra and its overlying skin cover without any incidence of fistula formation.

REFERENCES

1- Harrison D.H.: Reconstruction of the urethra for hypospadiac cripples by microvascular free flap transfers. Br. J. Plast. Surg., 39: 408-413, 1986.

2- Gilbert D.A., Devine C.J., Jr. Winslow B.H., Horton C.E. and Getz S.E.: Microsurgical hypospadias repair. Plast. Reconstr. Surg., 77: 460, 1986.

3- Elder J.S. and Duckett J.W.: Complications of Hypospadias Repair. In F.F. Marshall (Ed.), Urologic Complications. Chicago: Year Book Medical Publishers, 1986.

4- Retike A.B., Keating M. and Mande L.J.: Complications of hypospadias repair. Urol. Clin. North Am., 15: 223, 1988.

5- Vorstman B., Horton C.E. and Devine C.J.: Current hypospadias techniques. Ann. Plast. Surg., 18: 164, 1987.

6- Horton C.E., Jr. and Horton C.E.: Complications of hypospadias surgery. Clin. Plast. Surg., 15: 371, 1988.

7- Bracka A.: A long term view of hypospadias. Br. J. Plast. Surg., 42: 251, 1989.

8- Chang T.S. and Hwang W.Y.: Forearm flap in one stage reconstruction of the penis. Plast. Reconstr. Surg., 74: 251, 1984.

9- Morison W.A., Webster H.R. and Kumuta S.: Urethral reconstruction using the radial artery forearm free flap: Conventional and prefabricated. Plast. Reconstr. Surg., 97: 413-19, 1996.

10- Luo C.C., Huang C.S., Lin J.Y., Huang C.F. and Chen Z.C.: Free Radial Forearm Flap in an Adult with Hypospadias Case report. Ghng Gung Med. J., 30: 168-71, 2006.

11- Kanno T., Shibasaki N., Ito M., Tsujyi Y., Taky Y., Takeuchi H., Mihara H., Ikeda M. and Yoshimoto Y.: Infection-induced urethral defect treated by urethra reconstruction with a radial forearm flap. International Journal of Urology, 12: 228-230, 2005.

12- Santanelli F. and Paolini G.: Glans, Urethra and Corporeal Body Reconstruction by Free Osteocutaneous Forearm Flap Transfer Annals. Plast. Surg., 50 (5): 545-549, 2003.

13- Semple J.L., Boyd J.B., Farrow G.A. and Robinette M.A.: The "cricket bat" flap: A one-stage free forearm flap phalloplasty. Plast. Reconstr. Surg., 88: 514, 1991.

14- Young V.L., Khouri, R.K., Lee G.W. and Nemecek J.A.: Advances in total phalloplasty and urethroplasty with microvascular free flaps. Clin. Plast. Surg., 19 (4): 927-38, 1992.

15- Lee G.W. and Khouri R.K.: Reconstruction of a near total male urethral defect with a microvascular free flap. J. Urol., 149: 1548-50, 1993.

16- Shcheplev P.A., Adamian R.G., Abbakumov L.A. and Amosov F.R.: Subtotal and total urethroplasty in men using a free vascularized radial skin flap. Urol. Nephrol. (Mos), (3): 36-9, 1996.