Ann R Coll Surg Engl 1998; **80**: 161–168

Newer concepts in the management of hypospadias and its complications

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Key words: Hypospadias; Complications of hypospadias; Urethral construction; Preputial flap; Urethra

Hypospadias is a common condition, estimated to occur once in 300 male live births *(1)*. The urethral meatus may be situated anywhere between the normal position, at the tip of glans to the perineum, on the ventral aspect of the penis. It is commonly, but not always, associated with ventral curvature of the penis termed chordee. There is a hooded prepuce and deficient ventral penile skin in most cases.

History of hypospadias surgery makes fascinating reading and gives an insight into the ingenuity as well as frustration of surgeons owing to imperfect results of surgery. This in turn has resulted in a plethora of techniques since the first unsuccessful attempt at repair by Dieffenbach in 1838 *(2)* and the first successful repair by Anger in 1874 *(1)*. Since then well over 200 techniques have been described, but most of these have been minor modifications of techniques and principles enunciated in the later part of the nineteenth and earlier part of the twentieth century. Multistage procedures were in vogue and refinements of some of the basic principles were the mainstay of different techniques. These included: (1) Ventral tube or strip of skin *(1)*; (2) Perimeatal flaps *(3)*; (3) Free grafts *(1,4)*; (4) Penile or scrotal tissue for the tube and burying the penis in the scrotum *(3)*; (5) Urethral mobilisation for distal hypospadias *(3)* and (6) Buttonhole in preputial hood to transfer skin ventrally *(1)*.

During the last 30 years newer surgical techniques have evolved, with proper understanding of vascularity and healing of flaps. Advances in suture materials, catheters, dressings, haemostasis and magnification have all resulted in better cosmetic and functional results in a large percentage of cases in a single operation.

Based on a Hunterian Lecture delivered during the annual conference of the British Association of Urological Surgeons, held in Bournemouth on 24 June 1997

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Table I. Age incidence

Age in years	*No. of new cases (%)*	*No. of failed cases (%)*	*Total (%)*
0–2	49 (16.11)	3 (1.46)	52 (10.21)
2–5	141 (46.38)	56 (27.31)	197 (38.70)
5–10	61 (20.06)	52 (25.36)	113 (22.20)
10–15	27 (8.88)	34 (16.58)	61 (11.98)
15–20	16 (5.26)	26 (12.68)	42 (8.25)
>20	10 (3.28)	34 (16.58)	44 (8.64)
Total	304 (59.72)	205 (40.27)	509

During the last 5 years we have treated 304 (59.72%) cases of hypospadias and 205 (40.27%) cases of complications of operated hypospadias (Table I), which include our own cases and those referred from other centres, by different techniques and in this article we describe the present trend and our own preferences.

Glanular and coronal hypospadias (cosmetic appearance)

Until recently, it was suggested by many that glanular and balanitic hypospadias required no correction as there is no functional deformity *(1)*. In fact a coronal position of the meatus after hypospadias operation was considered satisfactory *(5)*. Cosmetic appearance was considered secondary and usually of more concern to the parents than the patient *(1)*. Such views were justifiable then, as there was no satisfactory one-stage repair technique to correct a glanular or coronal hypospadias and attempts to bring the meatus to the tip of the glans failed in a large number of cases. Today these cases can be corrected in one stage as a day case, which takes a little more time than circumcision—meatal advancement and glanuloplasty (MAGPI-Duckett) *(6)*.

In our series, over the last 5 years, 52 (17.11%) cases have benefited by this technique with a satisfactory

Table II. Operative procedures and results of primary surgery for hypospadias

Operative technique	*No (%)*	*Failure*	*%*
1 Chordee without hypospadias			
(a) Skin and dartos chordee (with dorsal plication)	8 (2.63) (3)	0	0.00
(b) Congenital short urethra	2 (0.66)	0	0.00
2 MAGPI repair (with dorsal plication)	52 (17.11) (2)	5	9.61
3 Perimeatal flap	4 (1.31)	0	0.00
4 Inner transverse preputial patch (with dorsal plication)	119 (39.14) (13)	13	10.92
5 Inner transverse preputial tube (with dorsal plication)	107 (35.20) (7)	18	16.82
6 Byars' two-stage	12 (3.95)	2	16.66
Total	304	38	12.50

outcome in 47 (90.39%) (Table II). A variation of MAPGI, the Arap procedure *(7)* uses a midline suture of a fringe of skin proximal to the coronal meatus after a circumcoronal incision. The glanular tissue is then brought together. We had found no advantage of this procedure over a standard MAPGI and failure rate is higher.

Transverse preputial skin patch/tube

The inner layer of the prepuce is in texture nearest to the distal urethra and when used in the transverse axis gives an adequate length to form the distal urethra in hypospadias, as a tube or a patch, except in the most severe proximal hypospadias. The inner transverse prepuce was used as a free graft to make a tube *(4)* for repair of hypospadias with chordee in one stage. Transverse preputial flap urethroplasty, based on the superficial dorsal vessels of the penis, has stood the test of time. Since it was first used by Asopa *et al. (8)*, its various modifications and refinements are the mainstay of one-stage repair of hypospadias, as healing is better, because the transferred skin carries its own blood supply.

Inner preputial island flap

The inner prepuce can be separated from the outer prepuce and penile skin with its own blood supply by the superficial dorsal vessels as shown by Duckett *(9)* and can be transferred ventrally as an island tube or patch. The raw area is covered in Byars' fashion *(10)*.

Double-faced preputial island flap

It was realised that the superficial dorsal vessels supply both inner and outer layers of the prepuce where its branches fan out transversely between the two layers of

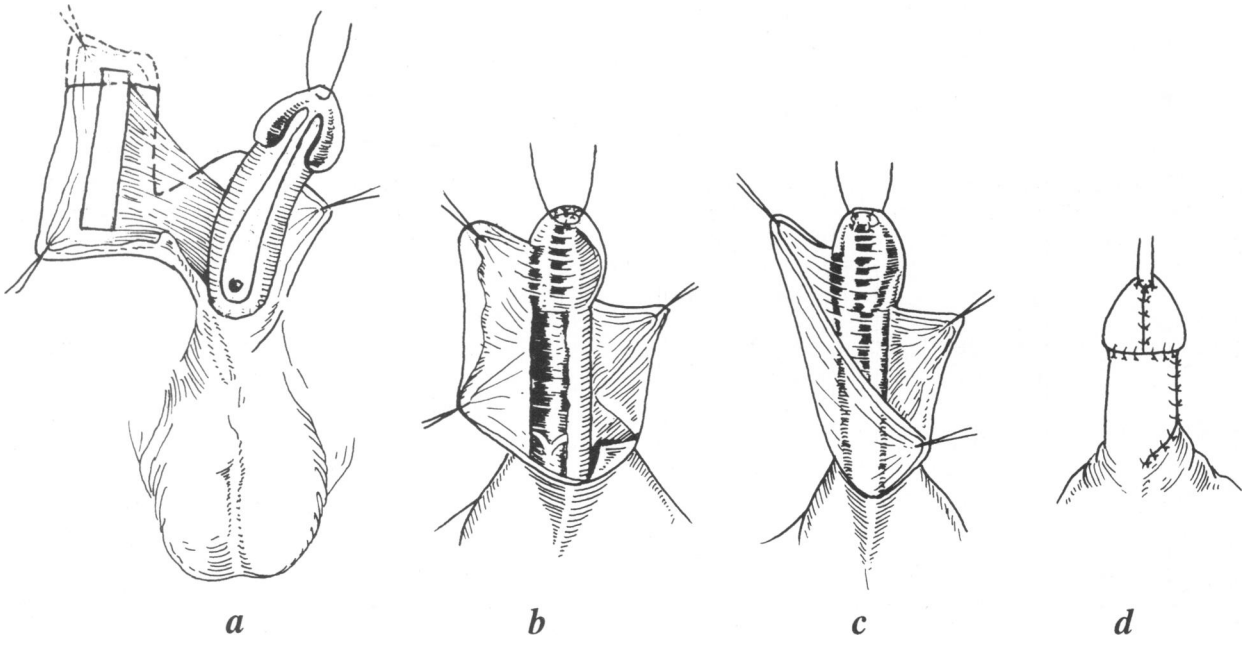

Figure 1. Inner transverse preputial patch urethroplasty. *(a)* Showing inner transverse preputial patch, urethral plate and oblique cut in outer preputial skin on left side protecting the vascular pedicle. *(b)* Inner transverse preputial patch stitched to the urethral plate on both sides. *(c)* Spiralling the penile skin to cover the ventrum. *(d)* Final result.

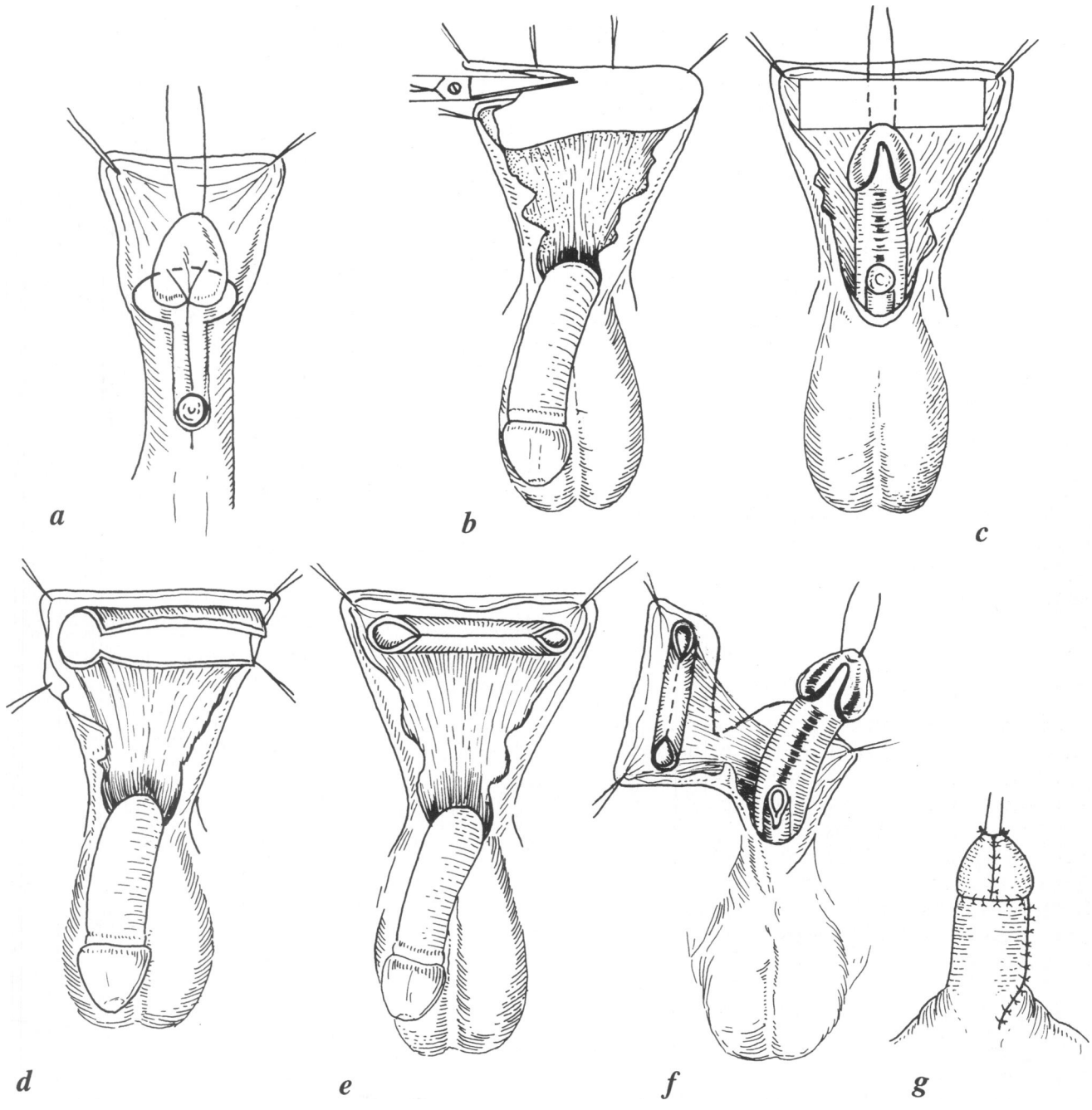

Figure 2. Inner transverse preputial tube urethroplasty. *(a)* Incision (rachet shaped). *(b)* Raising the inner transverse preputial flap. *(c)* Chordee corrected. *(d)* and *(e)* Tube is made from inner transverse preputial flap. *(f)* Oblique cut in outer preputial skin on left side protecting the vascular pedicle. *(g)* Final result.

the prepuce and when the penile skin is raised over the vascular pedicle, the inner preputial tube can be transferred ventrally with the outer prepuce covering it *(3,11)*. The penile skin, when stitched around the corona and outer prepuce, gives an excellent cosmetic result.

The island flap and double island flap give excellent cosmetic results, looking similar to a normal circumcised penis. The complication rates vary considerably and the good results obtained by some *(3)* are not duplicated by others *(12,13)*. Complication rates vary from 3.7% to 69% *(12,13)*, probably owing to the separation of the island. On the other hand, a vascularised transverse preputial flap attached to the outer prepuce but not freed as an island flap is more secure than island flaps *(14)*. The cosmetic appearance can be improved considerably by spiralling the flap around to the ventrum by an extended oblique cut in the skin between the penile skin and outer prepuce on one side *(14–16)*. The cut can be extended up to the midpoint of the penile skin, avoiding the dorsal vein and artery (Fig. 1, Fig 2). This gives a symmetrical skin cover and overcomes the torsion which is considerable if the oblique cut is incomplete. This, to some extent, is an incomplete double-faced island and heals better than a double-faced island flap. We have used this as a patch or tube in penile, penoscrotal and perineal hypospadias, with satisfactory cosmetic results.

Chordee

Though one-stage repairs of hypospadias have been undertaken since 1960, artificial erection on the table, introduced by Gittes and McLaughlin *(17)*, infused confidence in correction of hypospadias with chordee in one stage. It has also improved our understanding of the extent and incidence of chordee in hypospadias and in chordee without hypospadias.

Alternatives to artificial erection by injection of saline into the corpora, which we commonly use, are (1) pulling the glans by an anchor suture or between thumb and index finger and feeling the tightening of the urethra, the corpora cavernosa and the dorsal nerves. If chordee is present the corpora will be lax; (2) Blood can be pushed into the penile corpora by compressing the two crura of the penis and squeezing the blood into the penile corpora with the thumb and index finger. In most cases this can produce an artificial erection, enough to show the presence and extent of chordee in penile hypospadias. Using these manoeuvres, it has been realised that a high percentage of cases of distal penile hypospadias and some cases of proximal hypospadias have no chordee, or only dartos chordee which can be corrected when penile skin is raised over the shaft of the penis. These cases can be managed by a transverse preputial patch over the urethral plate with or without dorsal plication *(18)*. Cases with considerable chordee require division and mobilisation of the urethral plate proximally, beyond the meatus, and distally deep to the glans. Urethroplasty is performed by bridging the gap with a transverse preputial skin tube. A long spatulated anastomosis is made proximally and the distal end is brought out to the tip of the glans through a tunnel or glans split. It has been observed that in spite of extensive mobilisation of the divided urethral plate, some cases still have considerable chordee. These are corrected by dorsal plication *(18)*.

Mobilisation of the urethral plate

Following the use of a mobilised urethral plate without dividing it in epispadias *(19)*, interest was aroused for a similar technique in hypospadias *(20,21)*. The urethral plate is dissected free from the tunica albuginea and the fibrosed corpus spongiosum excised. It is reported that chordee can thus be corrected in even the most severe forms of hypospadias *(21)*. After a few attempts, we have not been convinced about this claim. The thin strip of mucosa, with a length of about 4 to 6 times its width, seems unlikely to have a viable vascularity. The good results reported are in all probability owing to the good vascularity and healing potential of the transverse preputial skin patch. Similar views are shared by others *(18)*.

Two-stage repairs

Though some surgeons use one-stage repairs, even in the most severe perineal hypospadias, others have continued or reverted back to two-stage procedures. We reserve two-stage repairs for severe forms and favour Byars' two-stage *(10)* technique. Other commonly used techniques are Durham Smith *(22)* and Fuqua *(23)*.

Materials and methods

During the last 5 years, 304 fresh cases, varying in age from 1 to 36 years (Table I), of hypospadias of different grades have been operated upon at our centre, including 10 (3.28%) cases of chordee without hypospadias, using appropriate techniques (Table II). In all 52 (17.11%) cases of glanular and coronal hypospadias were treated by meatal advancement and glanuloplasty. A perimeatal flap was used in 4 (1.31%) cases only. Inner transverse preputial skin patch over the urethral plate was used in 119 (39.14%) and an inner transverse preputial skin tube was used in 107 (35.20%) cases. Only 12 (3.95%) cases required two-stage procedures; 25 (8.22%) cases required dorsal plication (Table II). The bladder was drained by per urethral catheter which was removed after 1 day in cases undergoing MAGPI.

Results

The overall complication rate was 12.50% and the breakdown is depicted in Table II.

Discussion

The overall age at operation was higher than in other reported series as patients reported late, though our preferred age for surgery is 1.5 years. The oldest patient was 36 years of age (Table I). Fifty-two cases (17.11%) were corrected by MAPGI (Table II); most centres perform MAGPI in a higher percentage of cases. The smaller percentage of MAGPI in our work may be because a large number of our cases are referred from other centres, and cases of glanular and coronal hypospadias are dealt with elsewhere. Minor defects without chordee may not report for surgery in developing countries. I feel anything proximal to the corona is not suitable for MAGPI and we prefer to use a transverse preputial patch repair.

A vascularised inner transverse preputial tube or patch is the most commonly used flap for urethral reconstruction in one-stage repair of hypospadias *(3)*. The island flaps give good cosmetic results but the reported complication rate is variable and up to 69% *(13)*. The vascularity of the outer prepuce is often compromised and this has to be excised *(14)*. On the other hand, a flap urethroplasty, in which the two layers of the prepuce are not separated and the penile skin flap with the inner layer of prepuce, still attached to the outer layer, is transferred ventrally, is more secure and less likely to have a compromised vascularity. The complication rate varies from 5% *(24)* to 21% *(14)*. Our series has a complication rate of 10.92% in cases corrected by inner transverse preputial patch and 16.82% in cases in which an inner transverse preputial tube was used for hypospadias repair (Table II).

The superficial dorsal vessels fan out between the outer and inner layers of the prepuce and supply both these layers. This can be seen during dissection between the two layers. That an inner preputial island *(9)*, outer preputial island *(25)* or a double-faced island *(11)*, all survive on the superficial dorsal vessels alone, is ample proof of this. The extended oblique cut maintains symmetry and avoids torsion, and thus gives good cosmetic results (Fig. 1, Fig. 2).

In cases where the urethral plate is used to form a part of the circumference of the urethra without chordee or when mild chordee is corrected by dorsal plication, the complication rate was lower, 10.92%, compared with when the urethral plate had to be divided 16.82% (Table II). Similar difference was reported by Duckett *(18)*. When there is no chordee or when only dartos chordee is present, the urethral plate does not need to be transected or mobilised. Keeping the urethral plate intact has the advantage that the blood supply is not interfered with and the urethra does not have to be fixed to the tunica albuginea. Dorsal plication will correct mild chordee, and the urethral plate can be used with advantage. We have resorted to the above techniques in 119 cases and the results, when the urethral plate is utilised to form part of the circumference of the urethra, are 10.9% (complication rate) compared with 16.8% when the urethral plate was transected and the whole tube was formed by inner prepuce (Table II). Some cases of curvature persist after excision of the ventral chordee and these cases require dorsal plication *(18)* or ventral incision with dermal or tunica vaginalis testis grafting *(3)*. Our preference has been dorsal plication; this was required in 25 cases (8.22%) (Table II).

Conclusion

The aim of hypospadias repair is to provide a good cosmetic and functional result with the patient able to pass urine from the apex of the glans, preferably in a single operation. Newer surgical techniques have made it possible to achieve these goals with a first operation failure rate of around 10%. In one-stage repair, when the urethral plate is used to form a part of the circumference of the neourethra, the complication rate is much lower than when the urethral plate has to be transected. The technical advances by way of fine absorbable suture materials, optical magnification, soft sialastic catheters and dressing materials have added to the confidence in providing better results. Many centres operate around 6 to 18 months of age as a day case procedure. The results may improve further with the expected use of laser welding and tissue adhesives *(21)*.

Complications

Common complications of hypospadias are fistula, stricture, recurrent or residual chordee, diverticulum and retrusive meatus. These are avoided by selecting the appropriate procedure for each case, attention to detail, careful handling of tissues and the use of fine absorbable suture materials. Though the complication rate has come down in recent years with the newer techniques, complications, especially fistula, are likely to continue for many years *(3)*; reported rates vary from 0% to 69% *(12,13)*.

Once a fistula develops, one should wait for at least 6 months for inflammation and induration to resolve *(26,27)*. Though this statement is true for two-stage repairs when the skin suture line is in the midline, overlying the neourethra, when a flap is used for treatment of hypospadias or its complications we have been resuturing the skin flap, if a moderate sized fistula is detected during a change of dressing, between the 7th and 12th postoperative day. The flap is raised and advanced a few millimetres and resutured overlapping the fistulous opening in the urethra. There was rapid and satisfactory healing in 21 of 26 cases of primary hypospadias repair with a flap and when a flap was used for postoperative complications, thus avoiding repeat surgery. Fistula may be associated with stricture, diverticulae or chordee and these should be corrected at the time of fistula closure.

Materials and methods

Over the last 5 years we have operated on 205 cases of failed hypospadias (Table I), these include our own and cases referred from elsewhere. We group these cases according to the site and number of fistulas, associated problems, such as stricture, retrusive meatus, diverticulum chordee, and the type of surgery contemplated.

Simple fistula in proximal penile part without stricture diverticulum or chordee

These can be treated as a day case procedure, with a local flap. The fistulous tract is excised down to the urethra and the areolar tissue around the fistulous opening in the urethra is closed with 6/0 Vicryl®, the skin or mucosa is not repaired. A proximal or distal based local flap covers the fistula site so that the skin suture line is some distance away from the fistula site (Fig. 3). This is assured by suturing subcutaneous tissue of the flap to the tunica albuginea. Urinary drainage is not usually required.

Multiple fistulas without chordee or stricture and coronal fistula

A circumcoronal incision is made and the penile skin raised, after circumscribing the fistulous openings. The fistulous tracts are excised down to the urethra and bridges of skin between the fistulas are cut open to communicate the fistulas. The areolar tissue around the urethra (Fig. 4) is closed with 6/0 Vicryl. The penile skin is rotated around the shaft of the penis by about 10° so that the lateral penile skin covers the site of the fistulas and the skin suture line lies laterally away from the suture line of the fistula closure.

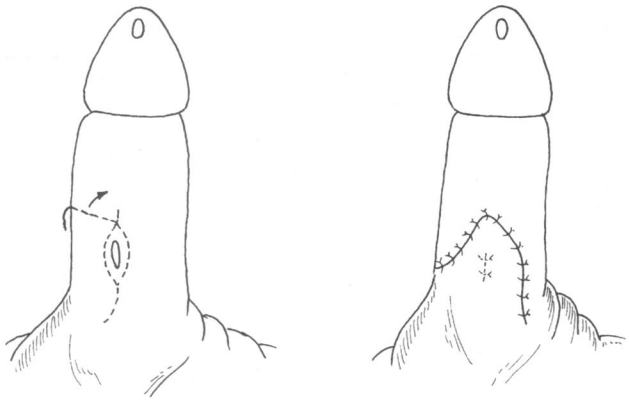

Figure 3. Closure of urethral fistula (after hypospadias surgery) by local flap advancement. *(a)* Incision. *(b)* Local flap is advanced to cover the stitched fistula site.

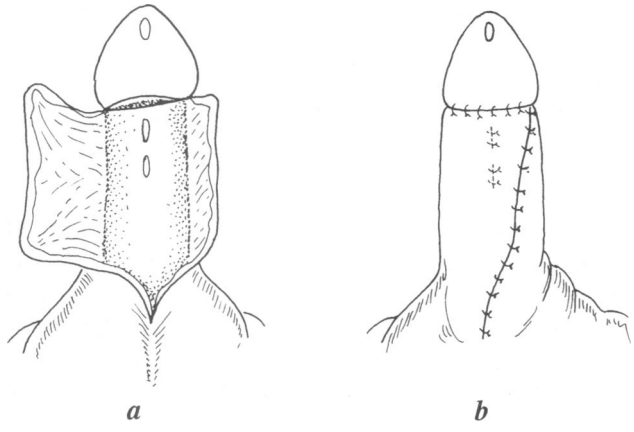

Figure 4. Closure of multiple urethral fistulas after hypospadias surgery. *(a)* Penile skin raised after circumcoronal incision. *(b)* Fistula site is stitched and penile skin is rotated by 10°, so that skin suture line does not overlap the stitched fistula site.

Fistulas with stricture and/or chordee with intact prepuce

Penile skin is raised with the prepuce, preserving the superficial dorsal vessels of the penis. The urethra is laid open proximal and distal to the fistula. The chordee, if present, is corrected. A transverse preputial patch/tube is utilised to refashion the urethra as necessary.

Fistulas with chordee or stricture without prepuce

These are best treated in two stages. The penile skin is raised after circumcoronal incision. The chordee is corrected and the penile skin is redistributed in Byars' fashion *(10)*. After 4 to 6 months the urethra is constructed in the midline and lateral flaps are used to cover the constructed urethra or buried skin strip.

Fistulas with chordee with scarring of tunica and shortage of skin

These very complex cases have been called hypospadias cripples. After excision of scar tissue and correction of chordee there is not enough skin to cover the raw area on the ventrum. We have evolved a two-stage operation for such cases. After chordee correction, a skin tube is made from the median raphe of the scrotum, and the penis is buried in the scrotum as a first stage (Fig. 5). The scrotal tube is anchored to the tunica albuginea and penile skin is stitched to the scrotal flaps. After 3 to 4 months the penis is released from the scrotum (Fig. 6).

Retrusive meatus alone or associated with above defects

Meatal advancement and glanuloplasty, or perimeatal flaps, are used for a retrusive meatus, with or without the above operative techniques, as indicated.

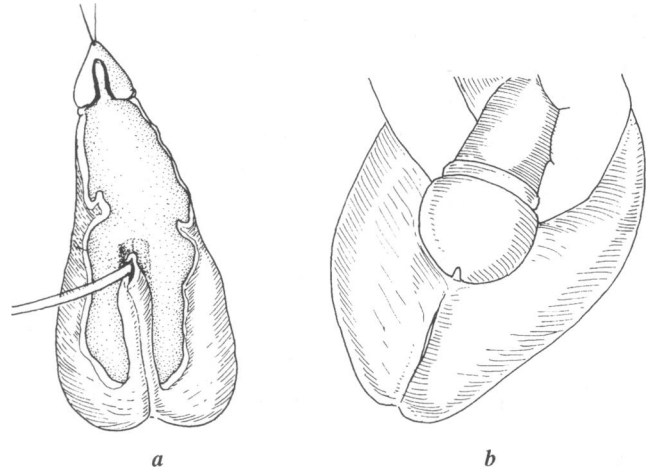

Figure 5. Two-stage repair of hypospadias cripples—Stage I. *(a)* Scar and chordee excised (note deficient penile skin on ventrum), glanular flaps raised and neourethra is constructed from median raphe of the scrotum. *(b)* Penis is buried in scrotum, stitching the penile and scrotal skin.

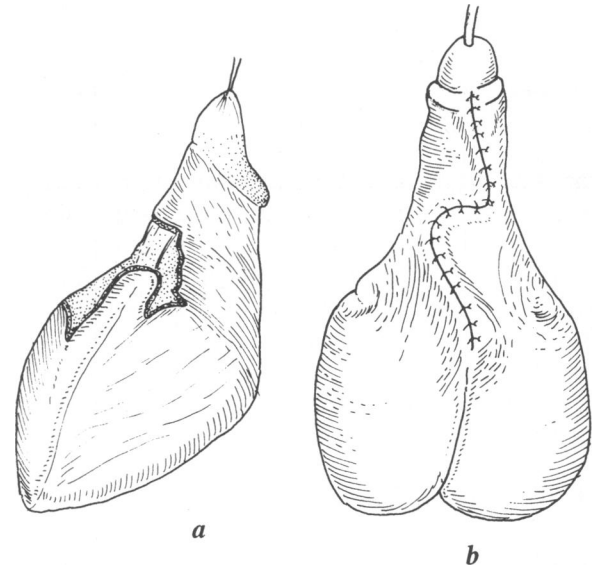

Figure 6. Two-stage repair of hypospadias cripples—Stage II. *(a)* Penis with neourethra is released from the scrotum, giving an incision in the scrotum protecting the neourethra, 3–4 months after stage I operation. *(b)* Final result.

Table III. Operative procedures and results of first attempt after primary surgery failure

Operative technique	*No. (%)*	*Failure*	*(%)*
1 Meatal advancement alone	10 (4.88)	1	10.00
2 Perimeatal flap	23 (11.22)	3	13.04
(with dorsal plication)	(1)		
3 Local flap for shaft fistula	67 (32.68)	8	11.94
(with meatal advancement)	(10)	2	
(with perimeatal flap)	(4)		
(with dorsal plication)	(2)		
4 Penile skin rotation	13 (6.34)	1	7.69
(with meatal advancement)	(0)		
(with perimeatal flap)	(1)		
(with dorsal plication)	(2)		
5 (a) Inner transverse preputial patch	24 (11.71)	2	8.33
(with dorsal plication)	(1)		
(b) Inner transverse preputial tube	22 (10.73)	3	13.63
6 Two-stage Johanson repair	23 (11.22)	5	21.73
(with dorsal plication)	(1)		
7 Scrotal rotation flap	7 (3.41)	0	0.00
(with meatal advancement)	(1)		
(with perimeatal flap)	(1)		
8 Scrotal bury	16 (7.80)	1	6.25
Total	205	24	11.70

Results

The breakdown of cases according to the procedures performed and the results are depicted in Table III.

Discussion

Surgery for hypospadias complications has a high failure rate *(3,26)*. Our series, which has a large number of complex fistulas with associated complications, referred from elsewhere, had a failure rate of 11.70% (Table III). Some authors have reported excellent results *(28)*, when urethra and skin were closed at right angles to each other. Others have reported good results in a small series, using Y–V advancement flap *(29)*. De-epithelialised 'pants over vest' has also given good results in midshaft fistulas *(30)*. Most reports with good results have used flaps in such a way that suture lines of urethra and skin do not overlap. These results have been obtained in simple fistula using a single technique. We have used assorted techniques for all complications of hypospadias surgery associated with hypospadias fistulas. The results are better when a flap is used to separate the suture lines of urethra and skin by a good margin (Table III).

Cases operated for complications of hypospadias surgery, either at our centre or elsewhere, varied in age from 2 years to 35 years (Table I). Most of the cases being referred for complications from other centres presented late (Table I). A perimeatal flap can be used for a retrusive meatus or when the meatus has been left just proximal to the corona; we do not mobilise the flap extensively. Two groups of cases are unique in our series. A large number of cases (22%) had an intact prepuce which we always used, utilising the inner prepuce as a patch or a tube. This was not only secure but also improved the cosmetic appearance and the meatus could be created at the tip of the glans. The high incidence of an intact prepuce in our referred cases is because many surgeons in India use a two-stage operation, without ventral transfer of preputial skin in the first stage.

Hypospadias cripples which have multiple fistulas, strictures, recurrent or residual chordee and shortage of penile skin can be treated by excision of scar tissue, correction of chordee and, if necessary, dorsal plication. In these cases, the penile skin cannot be closed at the initial operation (Fig. 5). Partial thickness skin, bladder, or buccal mucosa can be applied on the ventral surface of the raw area, and a tube constructed from this in the second stage. The failure rate is very high *(31)*. We construct a tube from the median raphe of the scrotum in the first stage and bury the penis in the scrotum. As these patients are adolescents or adults and had several attempts at repair, they are very anxious. We feel that if they can pass urine from the tip of the glans after the first operation, it provides a great moral boost. After 3 to 6 months the penis is released from the scrotum. This has given us excellent results (Fig. 6). The median raphe has very few hairs, and the hair-bearing urethra is in the pendulous part of the penis, hence pooling of urine does not occur, unlike when scrotal skin is used in the bulbar urethra. We have not encountered stone formation or hair balls since we started using this technique 15 years ago. The long-term results during the last 15 years have been encouraging (Table III).

I wish to thank my surgical associates, Dr Mukul Garg, Dr G G Singhal, Dr Kishore Panjwani, Dr Anil Yadav, Dr Lakhan Singh and the anaesthesiologists Dr Smita Sane, Dr Yogesh Kumar Singh and Dr Vanmala Yadav for their help in managing these patients.

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Received 16 July 1997