



Two-stage hypospadias repair: audit in a district general hospital

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Received 6 May 2003; accepted 7 August 2003

KEYWORDS

Hypospadias; Two-stage repair; Complications; Outcome

Summary The number of techniques for hypospadias repair is testament to the challenges associated with this condition. In 1994, the senior author undertook an audit of his repairs using the van der Meulen [Plast. Reconstr. Surg. 59 (1977) 20615] technique and determined that the revision rate of 11% was unsatisfactory and the cosmetic result sub-optimal. He, therefore, retrained and began in 1995, using the two-stage technique popularised by Bracka [Br. J. Plast. Surg. 48 (1995) 345]. We undertook an audit of all corrections performed in the period from September 1995 to March 2002. The computer database in the main theatre suite was used to identify all patients on whom such a repair had been undertaken and those notes retrieved. Data was collected on a number of variables including age at operations, complications such as urinary tract infection and fistulae, and total number of corrective operations. One hundred and nineteen patients were identified, of which seven had no records available. Of the remaining 112, 81 were primary repairs, in whom the complication rate was 2.5% for stage I (graft loss) and 9.8% for stage II (fistula rate 7.4%, stenosis 1.2%, baggy urethra requiring reconstruction 1.2%). The remaining 31 patients were those with unsatisfactory single-stage repairs and in this group, graft loss was seen in three cases (10%). The fistula rate was 4/31 (12.9%) and the stenosis rate 2/31 (6.5%). These results compare favourably with a number of published series from surgeons who have super-specialised in this field. We conclude that the two-stage repair is a useful and reliable technique in the hands of a Plastic Surgeon who has a broader interest. © 2003 The British Association of Plastic Surgeons. Published by Elsevier Ltd. All rights reserved.

Hypospadias is a congenital condition characterised by (primarily) an abnormal position of the urethral meatus, such that it lies proximal to the glans on the ventral surface of the penis (dystopic ventral meatus). It is associated with chordee of the penis, a relative lack of ventral skin and abnormal foreskin

development. In extreme cases the glans itself may be abnormally formed, resulting in clefting. The incidence of the disorder is approximately 1:250 live male births and 17% have associated urogenital abnormalities.³

The earliest treatment for hypospadias is attributed to Paul of Aegina, who advocated glandular amputation in order to position the meatus at the tip of the penis. Although radical, this method

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highlights one of the therapeutic challenges of the speciality; achieving a distal meatus. Modern hypospadias repair can be dated from Mettauer's technique, first used in 1830 and published in 1842. He described what might today be called a two-stage procedure; the first stage was to lay open the glans from the congenital meatus to the proposed site, and prevent closure by physical means. At a later date the lateral wound edges were 'freshened' and closed surgically around a splint, maintaining urethral patency. Others including Thiersch (1869) and Anger (1874) made further progress, and in 1874 Duplay described his transverse-incision method for releasing chordee, still in use today. The first epithelial inlay graft was used by Nové-Josserand in 1897 and although this original method struggled with graft contracture,⁴ it laid the foundations for modern practice.

In 1970, van der Meulen published his modification of the Duplay technique.^{1,5} This involved the transposition of a flap based on the adjacent penile skin to form a neo-urethra, followed by a 'wrap-around' of the preputial skin. The end result was a ventralisation technique that moved the meatus distally but did not attempt to sink the neo-urethra into the glans (Fig. 1). As such, the distal meatus formed was still on the ventral surface but transposed more distally to give a reliable repair;



Fig. 1 Cosmetically unsatisfactory van der Meulen repair.

in a review of cases, van der Meulen reported no fistulae in any case associated with chordee.⁵ Using this technique several authors have reported minimal complications with fistulae⁶⁻⁹ but other problems have included, particularly, urinary spraying in 8% and deviation of the stream in 32% of cases.⁹

The Bracka two-stage technique, as described in 1995,² involves splitting the glans and applying a full-thickness graft of skin, usually preputial. The graft was left to settle for a period of time (up to 6 months) before the second stage was embarked upon. In the second procedure, the revised anatomy could be reviewed and if unsatisfactory, further correction performed before embarking upon urethral closure. This closure involves tubularisation of the graft, followed by application of a fascial 'waterproofing' layer, before closure with remaining preputial skin. It is usual to perform a completion circumcision at this stage. The waterproofing layer is an important step in this technique; without it, Telfer et al.¹⁰ demonstrated a fistula rate of 63% but with it only 4.5%.

The results of this procedure vary widely. Bracka reported a fistula rate of 5.7% over 10 years, two-thirds of which occurred within his first three years;² this demonstrates clearly the learning curve for the technique. Trainees in the same unit had fistula rates of 15.2% for the same technique; in approximately half of cases they had been supervised. Subsequently, Johnson and Coleman¹¹ reported a 5% fistula rate whilst Schumacher et al. using another two-stage technique, reported a fistula rate of 7.9%.¹² Conversely, Hensle et al. in a small series, demonstrated complications in 37.5% of primary hypospadias repairs.¹³ These variations serve to highlight the difficult and delicate nature of this surgery and the problems associated with learning the technique. Ratan et al. have attempted to define determinants of fistulae formation, which include unfavourable anatomical factors, surgical dissatisfaction at the end of the procedure and local infection. Urinary leakage did not have a strong association with fistula formation.¹⁴

More recently, the cosmetic and psychological outcomes following hypospadias repair have received attention; Baskin has concluded that those undergoing standard two-stage surgery for primary hypospadias were very satisfied with the cosmetic outcomes; the end result was akin to a circumcised penis. He commented that this was not always the case in secondary surgery.¹⁵ Despite this, patients operated upon as children retained psychosexual problems to adolescence and, interestingly, there was little difference between those with ventralisation and those with terminalisation

procedures.¹⁶ In those receiving care later in life, the timing of completion of surgery adversely affected their development and 37% of adults were unhappy with the cosmetic outcome.

Methods

Prior to 1994 the senior author used the van der Muelen one-stage hypospadias repair,^{1,5,17} a procedure that is aimed primarily at advancing the meatus distally without terminalising it. The foreskin is transposed to provide a channel from the meatus to a ventral point distally, closer to the tip of the glans. In early 1995, the senior author reviewed his experience with this technique over the previous 10 years. Theatre logbooks and operative lists were reviewed to provide a list of those patients who had undergone hypospadias repair. Notes were retrieved and a limited review undertaken, with the primary intention of determining fistula rate. Other complications were noted.

Following this audit and the co-incident rise in popularity of the two-stage procedure, the senior author underwent re-training in order to provide a service based upon the two-stage method described by Bracka.¹⁸ This method was instigated in September 1995 and relies upon cleaving the glans in order to provide an anatomical position for the urethra, followed by grafting to that bed in order to (a) maintain the dissection, and (b) provide epidermal tissue for a neo-urethra. Grafts are taken from the adjacent prepuce in the vast majority of cases. At the second procedure, the urethra is closed around a catheter, a fascial 'waterproofing' layer is transposed over the suture line and the skin closed after a completion circumcision.

Patients undergoing the two-stage procedure consisted of new referrals and those in whom the previous one-stage repair had proven unsatisfactory. In the latter group, surgery begins with a formal dissection of the previous repair and removal of the preputial flap. This has the effect of returning the penis to its original state, though with the loss of some of the prepuce. A standard stage I procedure is then performed but in these cases buccal mucosa is used for the skin graft (Fig. 2). The donor site heals by secondary intention. Thereafter, the clinical management follows similar lines to that described above; the only main difference is in the dissection of the waterproofing layer during the second stage procedure; in these cases it may be difficult to identify sufficient tissue within the prepuce and it is the senior authors'

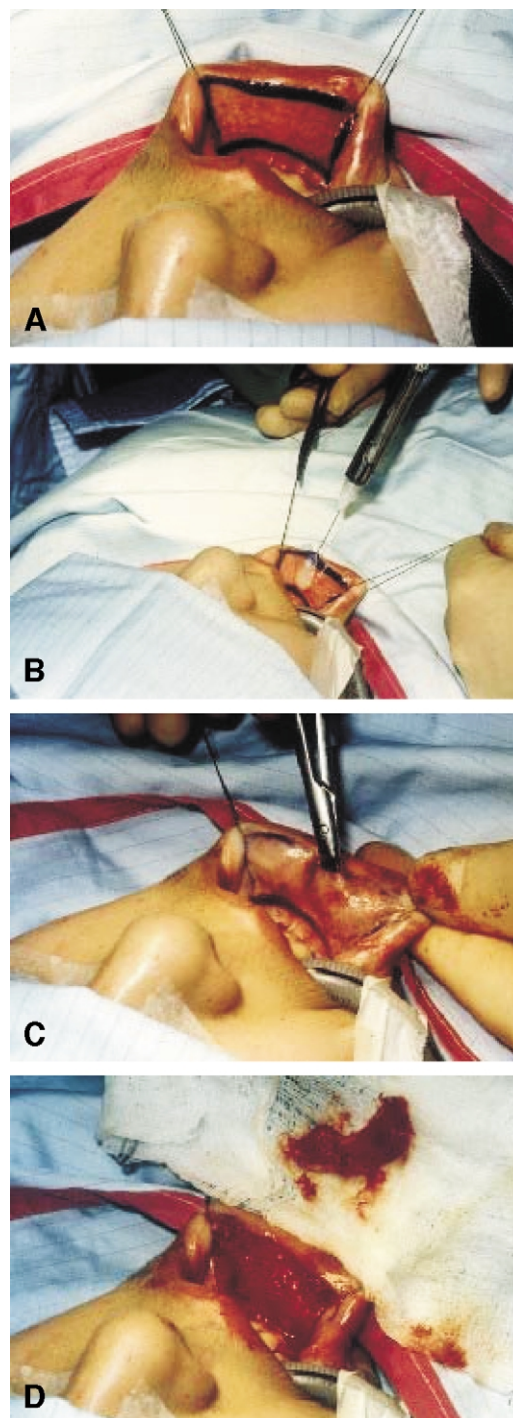


Fig. 2 Buccal mucosal graft harvest, (A) marked, (B) infiltrated with local anaesthetic and adrenaline, (C) dissection, (D) graft harvested.

usual practice to harvest from the dorsum as distally as possible.

The latest audit reviews all cases over the period from September 1996 to September 2001. A search was undertaken of the database held in the operating theatre based upon the codes for hypospadias procedures and details retrieved. Using this

list, all medical records were retrieved and individually assessed. Information was entered into a database (Microsoft Access 2000®, Microsoft Corporation) including demographic data, ages at operations and methods used (particularly for grafting).

Data from each group was assessed for a number of features. Analysis was primarily aimed at complication rates, including graft loss, urinary tract infection, stage I revision (necessitating deferral of stage II), fistula revision rates and further procedures subsequent to stage II repair.

Results

A total of 119 cases were identified, of which eight case notes were incomplete or not available. The remaining 112 were distributed anatomically as follows: 24 glandular, 52 coronal, 27 distal shaft, six mid-shaft and three scrotal (Table 1). The crude complication rates following surgery were as follows: graft loss was seen in five patients (4.5%). Fistula repair was undertaken in 10 patients (8.9%) and exploration for stenosis in three patients (2.7%). After all procedures ($n = 283$), a total of 10 patients had documented postoperative haemorrhage (3.9%).

Primary repairs

This group included 81 patients, mean age at first operation 3.5 years. One patient was six weeks of age, another eight years, but otherwise the range was 20 months to six years. Mean follow up was 3.4 years (range 7 months-8 years 7 months). The mean age at stage II was 4.4 years (range 7 months-9 years). 62 patients (76.5%) underwent successful repair in only two stages (Fig. 3). Of the remainder, a median number of three procedures were required (maximum of nine).

Those patients in whom the two-stage method was used as the first attempt at reconstruction suffered fewer complications than those undergoing conversion from the van der Meulen repair. Grafts were invariably taken from the prepuce and

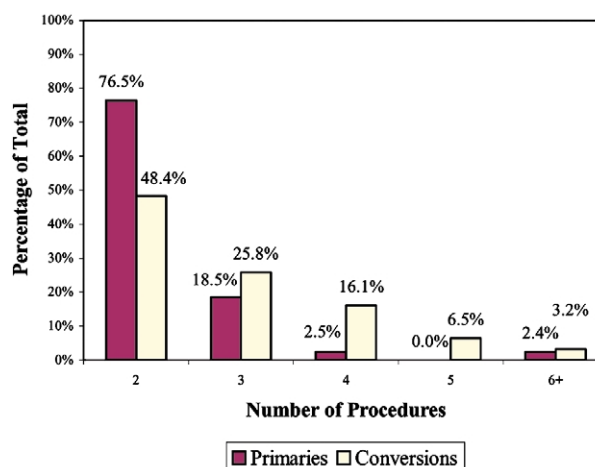


Fig. 3 Number of operations required before successful reconstruction.

four patients (5%) underwent re-grafting for partial or total failure, or graft contracture. One patient required three such revisions. After stage II, one patient (1.2%) required a single re-operation for stenosis, 6 (7.4%) underwent correction of fistulae and 1 (1.2%) for correction of urethral sac (flaccidity). All fistulae were successfully treated after a single further procedure, as was that for the patulous urethra. There were two documented cases of infection in 193 operations (1.0%) in this group and eight of haemorrhage (4.0%). Six of these followed stage I procedures, of which one required exploration. Partial graft loss was associated with haemorrhage in one (other) case. Figures are given in Table 2.

Conversions

Thirty-one patients were identified as having previously undergone hypospadias correction. All had previously undergone the van der Meulen one-stage repair and had been considered for further surgery because of cosmesis (30) or billowing of the urethra (1). Mean age at first operation was 10.1 years (range 1.8-21 years) and at second 10.7 years (range 2-25.4 years). Mean follow up was 3.3 years (range 1.1-7.9 years).

Patients in whom a previous repair had been performed required multiple operations, often for minor trimming or cosmesis (Fig. 1). Fifteen of the 31 patients (48.4%) were satisfied with the result after two procedures. Of the remaining 16, the median number of operations was three (mean 3.75, maximum six) and indications ranged from cosmetic (two patients) to complications (see below).

Stage I reconstruction was generally performed using buccal mucosal grafts with only 12 preputial

Table 1 Distribution of original position of meatus

	Primary repairs	Conversions
Glandular	17 (21%)	7 (22.6%)
Coronal	42 (51.9%)	10 (32.3%)
Distal penis	18 (22.2%)	9 (29%)
Shaft of penis	1 (1.2%)	5 (16.1%)
Scrotal	3 (3.7%)	0

Table 2 Comparison between those patients undergoing primary reconstruction and those converted from previous van der Meulen repairs

	Primary repairs	Conversion repairs
Mean age at stage I	3.5 years	10.1 years
Mean age at stage II	4.4 years	10.7 years
Duration of follow-up	3.4 years	3.3 years
Haemorrhage (stage I)	0	2 (2.4%)
Graft failure	4 (5%)	5 (16.1%)
Haemorrhage (stage II)	2 (6.5%)	2 (2.4%)
Fistula after stage II	6 (7.4%)	4 (12.9%)
Stenosis after stage II	1 (1.2%)	2 (6.5%)
Patients requiring two procedures	76.5%	48.4%
Median number of procedures ^a	3	3

^a Excluding those requiring only two procedures.

grafts used. One preputial graft contracted and was replaced subsequently with a buccal mucosal graft. Of the buccal mucosal grafts, two suffered partial loss and a further two contracture, making the complication rate with this graft 21% (4/19 grafts). There were no cases of haemorrhage after stage I in this group. Complications with buccal donor sites were rare; only one patient developed wound contracture, requiring scar revision.

Complication rates for stage II procedures were higher in those patients undergoing conversion from the previous ventralisation repair. Re-operation rates for fistula and stenosis were, respectively, 12.9% (four patients) and 6.5% (two patients). Of those patients requiring fistula repair, one underwent a total of four attempts before successful repair, and another required two. Both patients with stenoses required two dilatations before a good stream was achieved. Two patients (6.5%) suffered billowing of the reconstructed urethra and at operation a pre-meatal 'bulb' was demonstrated and repaired successfully. There was one documented wound infection (3.2%) and two cases of bleeding (6.5%), one of which required re-exploration. Figures are given in [Table 2](#).

Discussion

The history of hypospadias correction clearly demonstrates the challenging nature of this disorder; the number of procedures and their relative success rates underline the technical challenges to the surgeon. We sought to audit the results from a surgeon working in general plastic surgery, with an interest in this disorder, and to compare them to those obtained from super-specialists. The case mix at The Royal Preston Hospital includes those patients who had previously undergone a van der Meulen repair, and those referred de novo for

management. The two groups are disparate not only in the technical challenges they present, but also in the indications for operation; those in the conversion group were primarily dissatisfied with the cosmetic outcome of the repair and wished a terminalisation procedure, although some complained of the spraying associated with this repair. These dissatisfactions with the van der Meulen repair are similar to those reported by van der Werff and Ultee, who found post-micturition dribble in 16% of such repairs, as well as deviation of the urinary stream (32%) and excess skin (20%).⁹

The mean age at operation was understandably different between the two groups; mean age at first operation was 3.5 years in those referred primarily, as compared to 10.1 years for conversions and is considerably younger than in some series.^{13,19} Further, the interval between stages I and stage II was also dissimilar in both groups (1.1 years vs. 0.5 years, respectively), although the reasons for this appears unclear. The original description by Bracka suggested a six month hiatus¹⁸ but a period of deferment amounting to 1 year is not unusual.¹²

The more challenging group was, as expected, that in which conversion from a previous ventralisation technique was required and this reflects findings from other centres;^{11,20} The technical difficulties related to scarring from previous surgery is not offset by the ease of dissection associated with the increased dimensions of the penis with age. Further, in these patients the prepuce has already been transposed ventrally to provide cover for the neo-urethra and subsequent dissection often renders this flap useless for further surgery. However, in those cases in which it is retained, it may be used successfully in the second stage of the procedure. After dissection, the glans is cleaved and a graft inlaid. In our series, this is usually a buccal mucosal graft, reflecting the difficulty with using the preputial remnant. In conversion cases,

preputial grafts healed with greater success than buccal (91.7% vs. 79%) but for each complication only a single further procedure was required before successful grafting was achieved. Buccal mucosal grafts have been found to have higher failure rates; in their series, Metro et al. quote buccal graft failure in two cases from 30 (6.7%).²¹ The difficulties of grafting in these cases cannot, however, be attributed solely to the source of tissue; our series demonstrates 95% of (preputial) grafts took completely in cases of primary repair but only 91.7% in conversion cases, suggesting that the bed onto which they are placed may be inherently compromised.

Stage II surgery may be complicated by fistulae or stenoses and it is these that are usually cited as outcome measures. A brief summary of studies is given in Table 3, demonstrating the wide range of published results. In this study, only one of 81 primary repairs were complicated by stenosis (1.2%), and six by fistulae (7.4%). These results compare well with equivalent rates published by the original author and colleagues.^{2,10} Although a different two-stage technique was used, our results are also comparable to those of 7.9% (fistula) and 3.5% (stenosis) of Schumacher et al.¹² They clearly surpass those published by Hensle et al.¹³ and Ratan et al.¹⁴ although, both the latter authors published small studies and may have been marred by event bias.

Mucosal grafts have been associated with particularly high rates of stenosis; Metro et al. describe seven strictures in 30 cases (23.3%).²¹ In contrast, our series in conversion cases failed to show any stenosis with such grafts but did demonstrate two

fistulae in association with these grafts (19 cases), compared to two of each with preputial grafts (12 cases).

Results for conversion surgery are also commensurate with the literature; Bracka has published fistulae rates of 10.5% for revision surgery and although our figure is slightly larger, it is of the same order. Our stenosis rate of 6.5% is similarly of the same order as the original author,¹⁸ but unfortunately, there are few other studies comparing outcomes in revision surgery of this type.

Fistula repair after hypospadias surgery may be complex and refractory. In this study, only one fistula arose in a proximal hypospadias, whilst all others were found in the distal or anterior positions. It is the senior authors practice in these cases to repeat the stage II procedure by closing the urethra, transposing another interposition fascial flap, and then separately closing the skin. Using this technique, five of the six fistulae in the 'primary' group were closed successfully and two of the four in the 'conversion' group. The remaining fistula in the 'primary' groups required a second procedure, whilst those in the 'conversion' group required three and five procedures each. In other (larger) published series, Elbakry has successfully closed 30 of 42 fistula (71.4%) with a single procedure, 8/42 needing two and 4/42 requiring three operations.²² Shankar et al. quote a primary fistula closure rate of 71% in 113 children²³ and Latifoglu et al. 83.9% in 189 fistulae.²⁴ All three comment that distal fistulae were much more challenging than proximal, demonstrating the difficulties of re-operating in a field where much tissue has been scarred down and is no longer available to the surgeon.

The overall results of the study demonstrate that this form of specialist surgery may be successfully undertaken by the general plastic surgeon working in a District General Hospital, and that complication rates need not be markedly higher than those published by super-specialists. We are re-assured by the low complication rates and, although not reported here, the high patient satisfaction with the technique. We have found the cosmetic and functional outcome to be superior to the van der Meulen method and the complication rate, in our hands, lower.

Conclusion

We have successfully completed the audit loop set in motion five years ago when the senior author changed his practice in light of a complication rate he found unacceptable. We have demonstrated an

Table 3 Reported complication rates using a two-stage hypospadias repair

Author	Number in study	Complication	Rate (%)
Primary repairs			
Bracka	391	Fistula	5.7
		Stricture	7
Titley and Bracka	87	Fistula	8
		Stricture	2.3
Hensle et al.	8	Fistula	25
Ratan et al.	30	Fistula	53
Price et al.	81	Fistula	7.4
		Stenosis	1.2
Conversion/salvage surgery			
Bracka	209	Fistula	10.5
		Stricture	7
Metro et al.	30	Fistula	6.7
		Stenosis/stricture	36.7
Price et al.	31	Fistula	12.9
		Stenosis	6.5

improvement in fistula rates and have documented formally the stenosis and other complication rates associated with this method. Our results are comparable to leaders in the field using a variety of techniques.

The two-stage repair has been demonstrated to be a versatile repair, suitable for use in all positions of hypospadias. Furthermore, we have demonstrated that it can successfully be utilised to convert previously unsuccessful repairs with minimal further loss of tissue and trauma to the patient. Complication rates in revision surgery are higher than in primary, but comparable or superior to those found in the literature. We would advocate this method for recalcitrant cases and for those in whom previous outcomes have been poor.

Acknowledgements

We would like to thank the audit department at the Chorley and South Ribble NHS Trust, for their help with statistics, David Sharp from the theatre suite in the Royal Preston Hospital for retrieving patient details, and the medical records department for their help in tracking down medical case notes.

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