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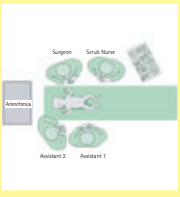


# Surgical Atlas
# The Cohen procedure

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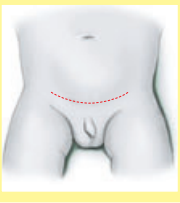
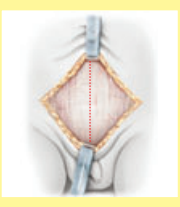
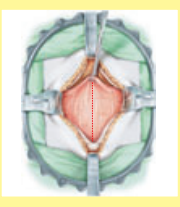
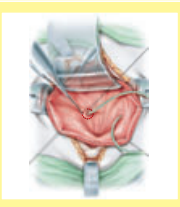
**ILLUSTRATIONS by STEPHAN SPITZER, www.spitzer-illustration.com**









## HISTORY

Pozzi first described the concept of VUR at the end of the 19th century. The antireflux mechanism of the vesico-ureteric junction (VUJ) was reported by Sampson in 1903 and in 1923 Graves and Davidoff stated that reflux does not normally exist [1].

VUR and associated renal lesions remained poorly understood until recently. Hodson and Edwards [2] in 1960 established a correlation between VUR and renal damage, and stressed the importance of pyelotubular back-flow of urine into certain papillae. In 1973 Bailey introduced the term 'reflux nephropathy' [3].

The concept of early damage of renal parenchyma ('big-bang') at the first UTI in infants with VUR and the potential danger of intrarenal reflux of infected urine into 'compound' papillae was proposed by Ransley and Risdon [4], and Smellie *et al.* [5] in 1975.

The surgical correction of VUR was widespread until it was documented that in many cases the reflux resolved spontaneously with the growth of the child, and the only treatment required was prophylaxis against UTIs. Although antibiotic prophylaxis remains a questionable treatment, the antenatal detection of urinary dilatation and reflux now provides an opportunity to commence prophylaxis soon after birth.

## PRINCIPLES AND JUSTIFICATION

VUR may be defined as a permanent or intermittent intrusion of bladder urine into the upper urinary tract caused by a defective VUJ. The defect in the junction may be a primary disorder or may arise secondary to a lower urinary tract dysfunction (neuropathic or unstable bladder) or BOO (PUV).

The refluxing urine can fill the upper excretory system (ureters and renal pelvis) between and/or during micturition, and can sometimes penetrate into the renal substance (intrarenal reflux). This latter event is caused by a defective calyco-tubular junction. The volume of refluxing urine can vary in the same patient at different times. Attempts to classify the degree of reflux are therefore of limited interest and do not influence practical decisions.

There are two essential clinical presentations of VUR:

(i) Major VUR associated with a dilated upper urinary tract on ultrasonography, antenatal ultrasonographic anomalies (dilatation), abnormal DMSA scans in over half of patients, and a low spontaneous cessation rate. This reflux essentially occurs in boys (90%) and results from a congenital malposition of the emergence of the ureteric bud, causing a morphological disorder at the level of the VUJ.

(ii) Far more frequent is VUR caused by a lower urinary tract dysfunction secondary to abnormal bladder urodynamics. This reflux usually causes no dilatation on ultrasonography, is not detected antenatally, is not associated with abnormal DMSA scans, and is usually found in girls not using their

bladder and bowel properly. The resolution rate is much higher (80%) than in the first group. This VUR responds well to bladder re-education and usually requires no radical treatment.

Hence these two groups of VUR have very different pathophysiology; in the first the VUJ is the problem ('reflux disease') and these patients are more prone to reflux surgery; in the second, VUR is only the visible part of the 'iceberg' ('reflux symptom') and is the consequence of underlying behavioural anomalies which need to be resolved first. There is obviously a grey zone between these groups and the difficulty arises in the correct causal diagnosis of this condition.

## VUR AND RENAL DAMAGE

What makes VUR bad for the kidney remains unclear; it can cause acquired lesions in the renal substance ('reflux nephropathy') or can be associated with congenital structural anomalies of the renal substance ('renal dysplasia').

The insult caused by VUR itself can either be a result of: (i) the intrusion of infected urine into the renal substance, and this is the most commonly accepted danger related to reflux; (ii) the abnormal urine pressure exerted by the reflux on the papillae; (iii) the abnormal biochemistry of bladder urine in the kidney; (iv) immune reactions caused by the penetration of lower tract proteins into the renal substance.

## INDICATIONS

As a consequence of the failure to reach a consensus on the precise indications for surgery, it is difficult to select the ideal treatment for each patient. The current policy is to prescribe prophylactic antibiotics for prolonged periods (12–36 months) in the expectation of spontaneous maturation of the VUJ (and resolution of the VUR). This policy involves repeated investigations to check if the VUR remains. The long-term side-effects of prophylactic treatment are unknown and there are reservations about its effectiveness in preventing infection. If the patient has recurrent breakthrough infections, or if there are signs of continued deterioration of the renal substance, more radical treatment should be offered. Surgery consists of re-implanting the ureters into the bladder; endoscopic treatment consists of injecting a substance behind the intramural ureter to create an *effective* posterior backing which helps to restore the antireflux mechanisms.

The aim of these treatments is to stop the VUR; this does not necessarily mean that the progression of renal damage is halted, or that further UTIs are prevented. In cases where the reflux has caused severe damage to the kidney (relative function <10%), a nephroureterectomy may be the best option. The choice between surgical or endoscopic correction of reflux is an individual matter, each technique having its protagonists.

## PREOPERATIVE ASSESSMENT

Before planning the operative correction of VUR a complete assessment of the urinary system is mandatory to understand in which category the reflux stands. The investigation should include the following.

### ULTRASONOGRAPHY OF THE URINARY TRACT

Although a poor investigation for the positive diagnosis of reflux, it is essential to define the degree of dilatation of the upper urinary tract and to evaluate the echogenicity of the kidneys, the bladder wall thickness and the postmicturition residue.

### CONTRAST CYSTOGRAPHY OR ISOTOPIC CYSTOGRAPHY

Direct contrast micturating cystography remains the reference standard investigation to detect VUR and to define the anatomy of the lower urinary tract. It is used during the first month of life when there is an antenatal suspicion of VUR, and is recommended after a first UTI in boys or girls at any age.

Indirect radioisotope cystography is favoured to follow children with reflux, as it avoids urethral catheterization, although used less often to detect reflux. Direct isotopic micturating cystography is probably the most sensitive investigation to detect VUR. The radiation dose is much lower than with contrast cystography but the child still needs urethral catheterization. Moreover, only a few centres can undertake this investigation in safe conditions.

The DMSA isotopic renogram is the reference standard to assess the presence of renal scars and it also provides a measure of the relative function of each kidney. In some cases it may be useful to complete the investigations with the following: *Urodynamic studies* are important for detecting an underlying bladder dysfunction; IVU is rarely indicated, and only if a specific anatomical situation needs to be clarified; *Cystoscopy* is used before surgery by some to evaluate the shape of the ureteric orifice and the length of the submucosal portion of the ureter. However, this assessment is often subjective and does not alter the therapeutic decision.

## ANAESTHESIA AND SURGERY

General endotracheal anaesthesia may be complemented by caudal anaesthesia. Trans-hiatal (Cohen procedure, Glenn-Anderson procedure) and supra-hiatal re-implantation of the ureter are the two main surgical options. Their aim is to mobilize the distal segment of the ureter(s) (transmural ureter) and place it under a tunnel of bladder mucosa, to restore the flap-valve mechanism which normally prevents VUR.

### TRANS-HIATAL REIMPLANTATION OF THE URETER

This is mainly represented by the Cohen procedure [6].



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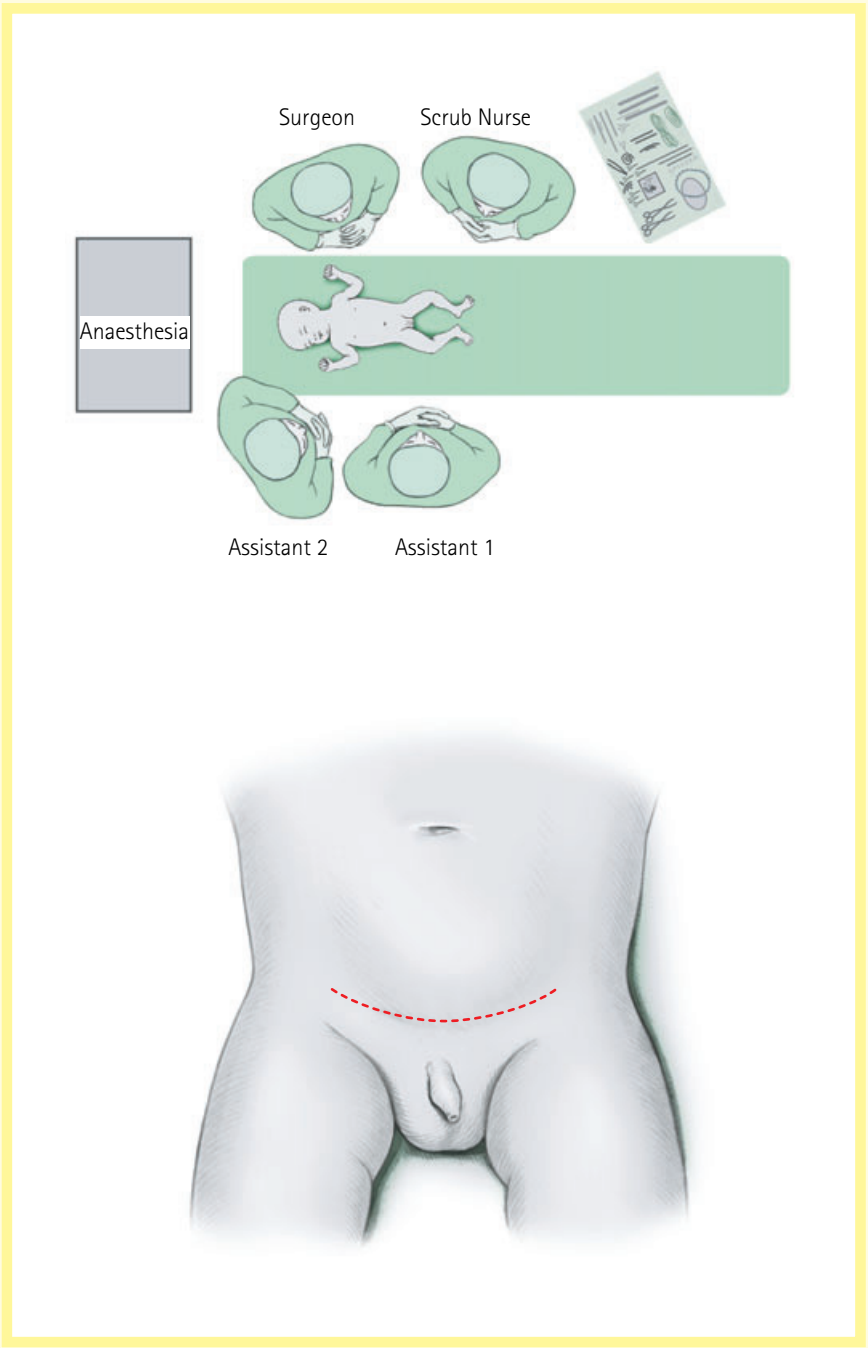
**Figure 1**

The patient lies supine on the operating table; a small sheet placed under the sacrum is useful to flatten the abdomen. A right-handed surgeon should stand on the left side of the patient, with the scrub nurse on the left of the surgeon. The two assistants should stand on the right side of the patient. A transverse suprapubic incision is made, 2 cm above the pubic symphysis, in the lower abdominal crease.

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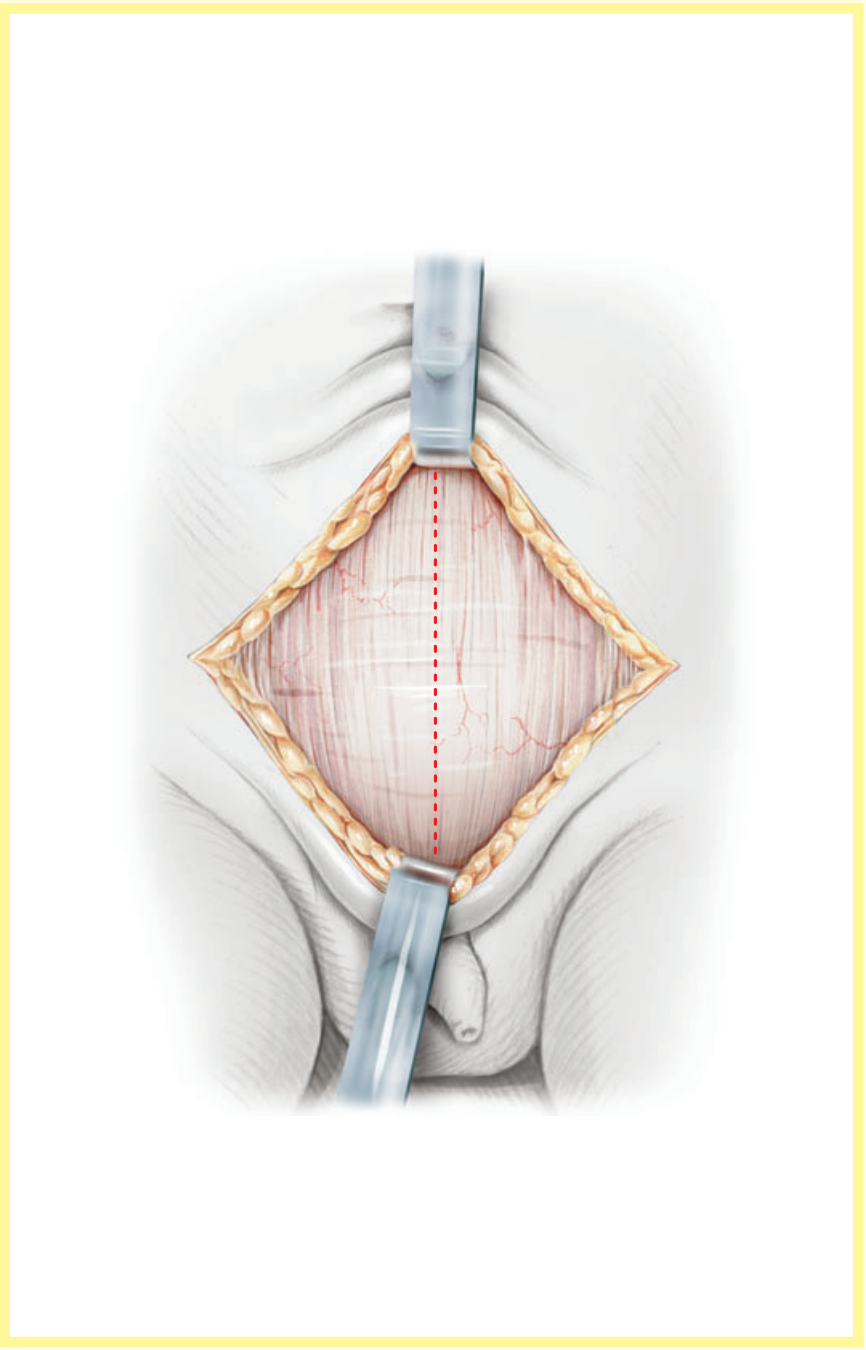

**Figure 2**

The subcutaneous tissues are incised, exposing the rectus sheath, which is opened vertically in the midline (dotted line). Both recti are separated and the peritoneum gently pushed upwards.



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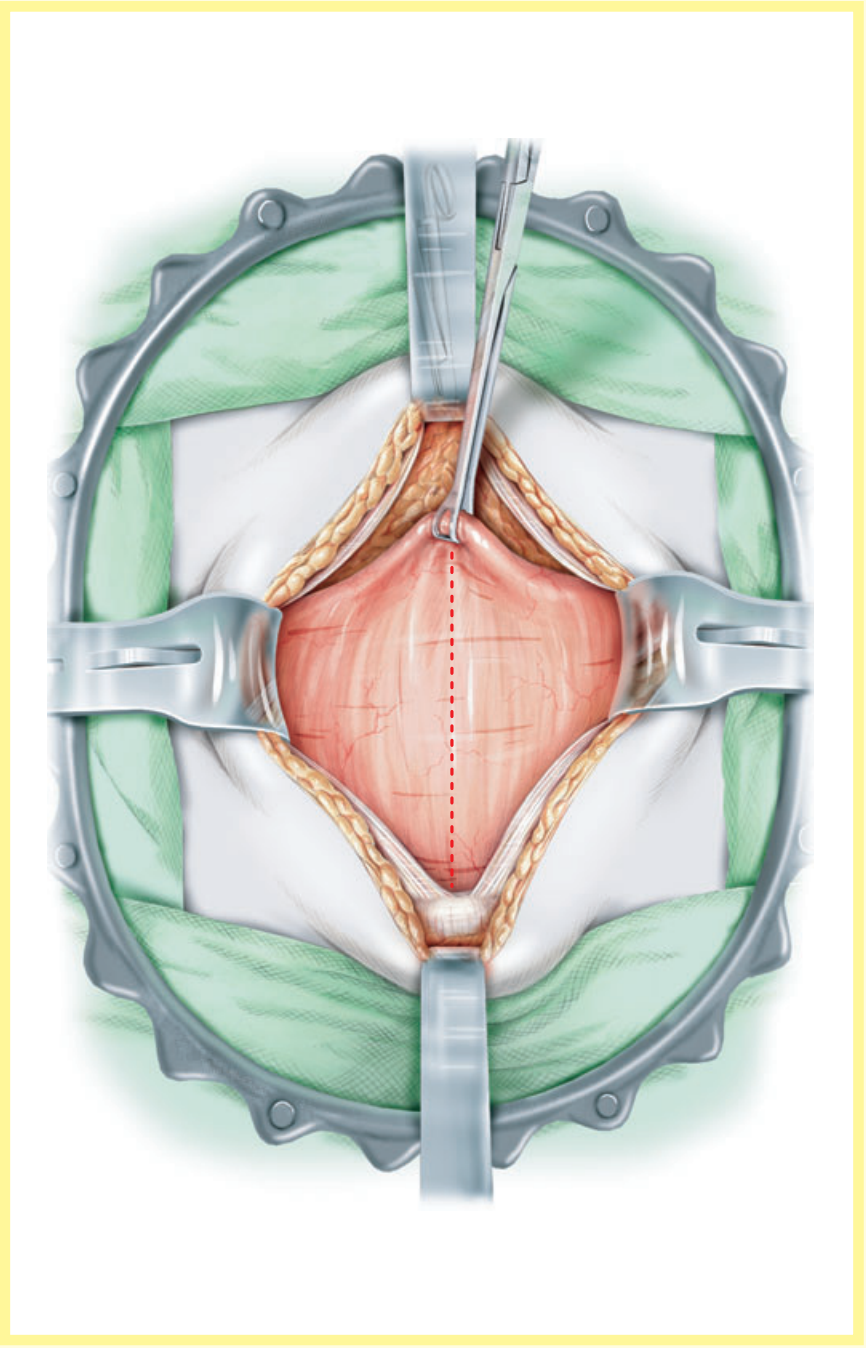
**Figure 3**

A Dennis-Browne retractor is inserted. The lateral blades retract the recti and the upper and lower blades retract the skin and subcutaneous tissues.



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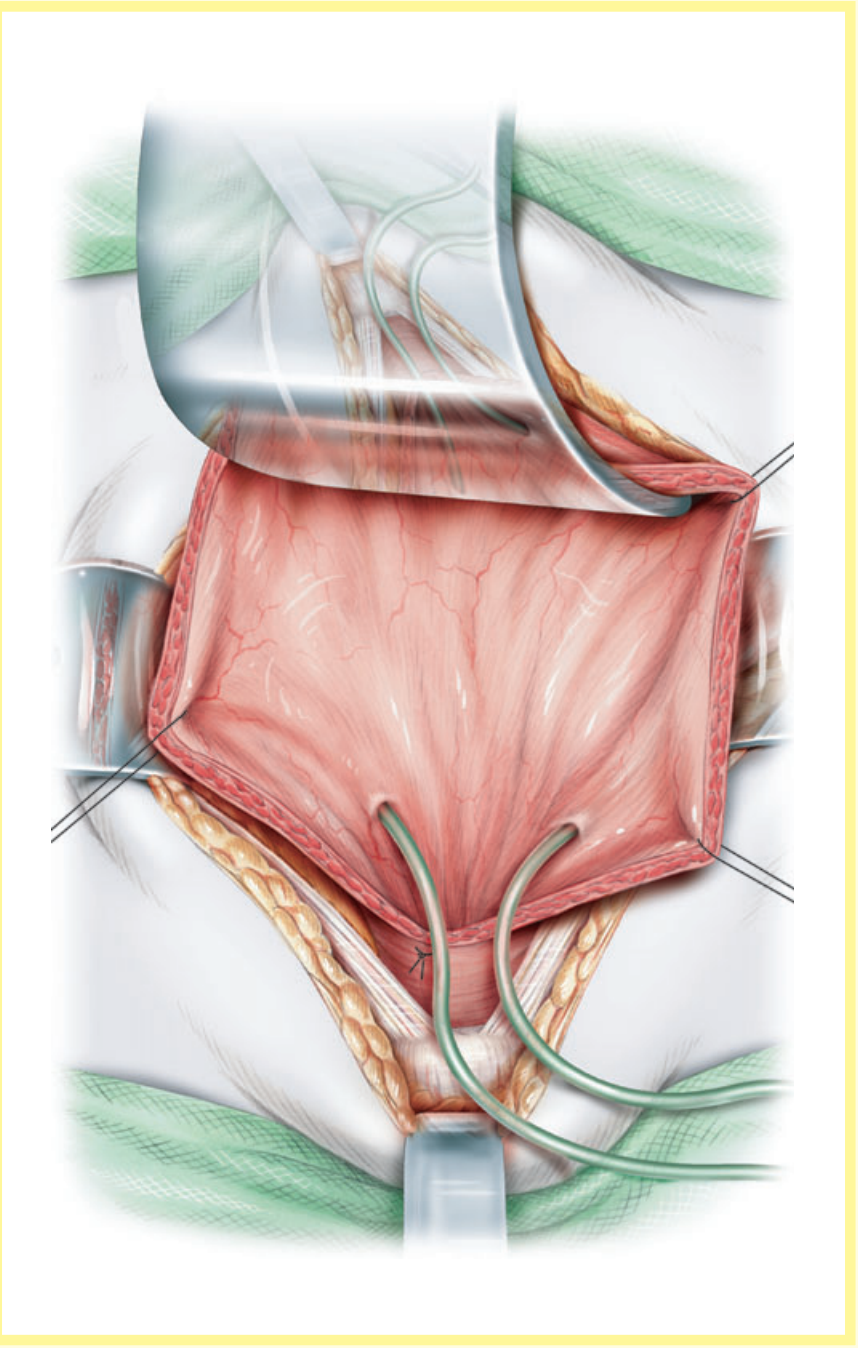

**Figure 4**

The anterior wall of the bladder is incised vertically and two or three stay sutures placed on each side to expose the bladder. To expose the trigone, one or several swabs are put inside the bladder and retracted upwards with a Deaver retractor held by the second assistant. A 3/0 or 4/0 absorbable suture is placed at the lowest point of the vesicotomy, to prevent splitting of the incision downwards into the bladder neck and the urethra.

The blades of the Dennis-Browne retractor should not be placed within the bladder for three reasons: (i) retraction is vigorous and may damage the bladder; (ii) access to the laterovesical spaces may be difficult; and (iii) the bladder wall loses its natural mobility, rendering the procedure more difficult. It is essential to avoid rigid retraction and to maintain the natural suppleness of the tissues.

The trigone is now well exposed and an infant-feeding tube (usually 4 F) is inserted into each ureter. A stay suture is placed around each ureteric orifice and tied over the feeding tube. The first assistant holds this stay suture with mild traction.



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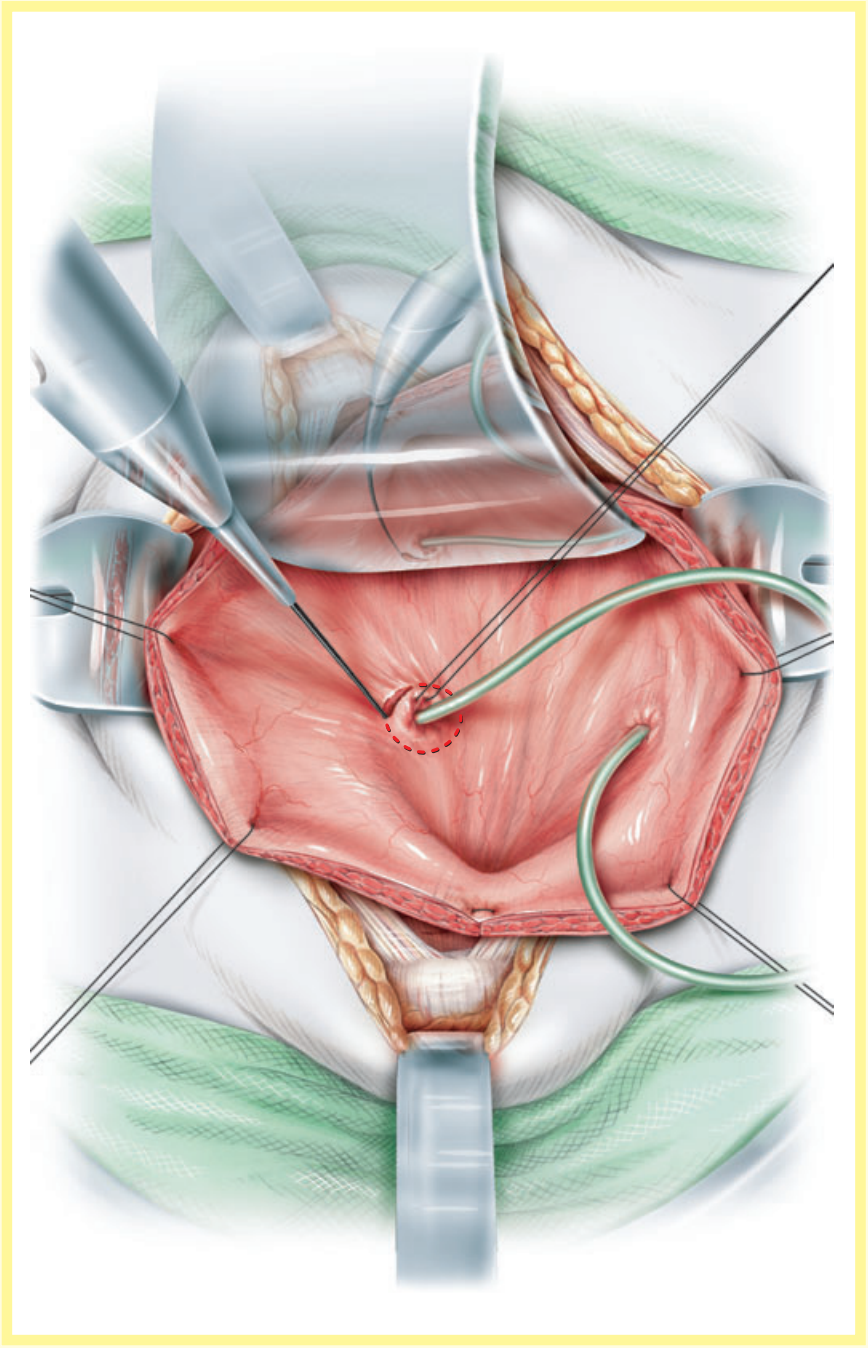
**Figure 5**

The ureteric orifice is circumcised with diathermy (cutting and coagulation current should be very low) and the distal 2 cm of ureter can be mobilised with diathermy alone (these 2 cm will be excised later).



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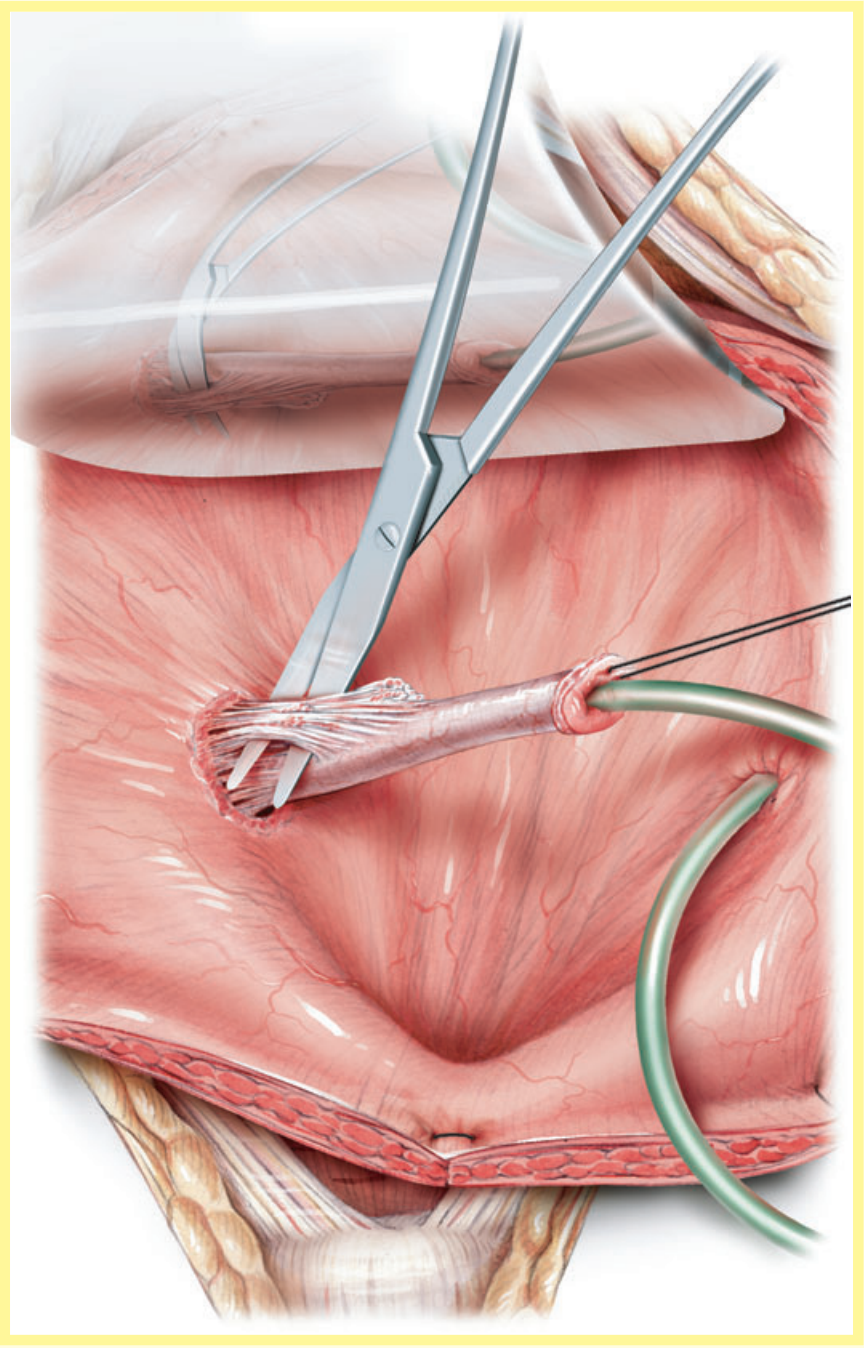

**Figure 6**

It is essential to enter the correct plane between the bladder and the transparietal ureter, commencing below the orifice. Sharp scissors should be avoided and Reynolds scissors make this procedure much easier. The tip of the Reynolds scissors elevates the muscle fibres that attach the ureter to the bladder musculature. These fibres are grasped with fine forceps, coagulated and divided. The fibres should be coagulated some distance from the ureter, to avoid damaging its blood supply.



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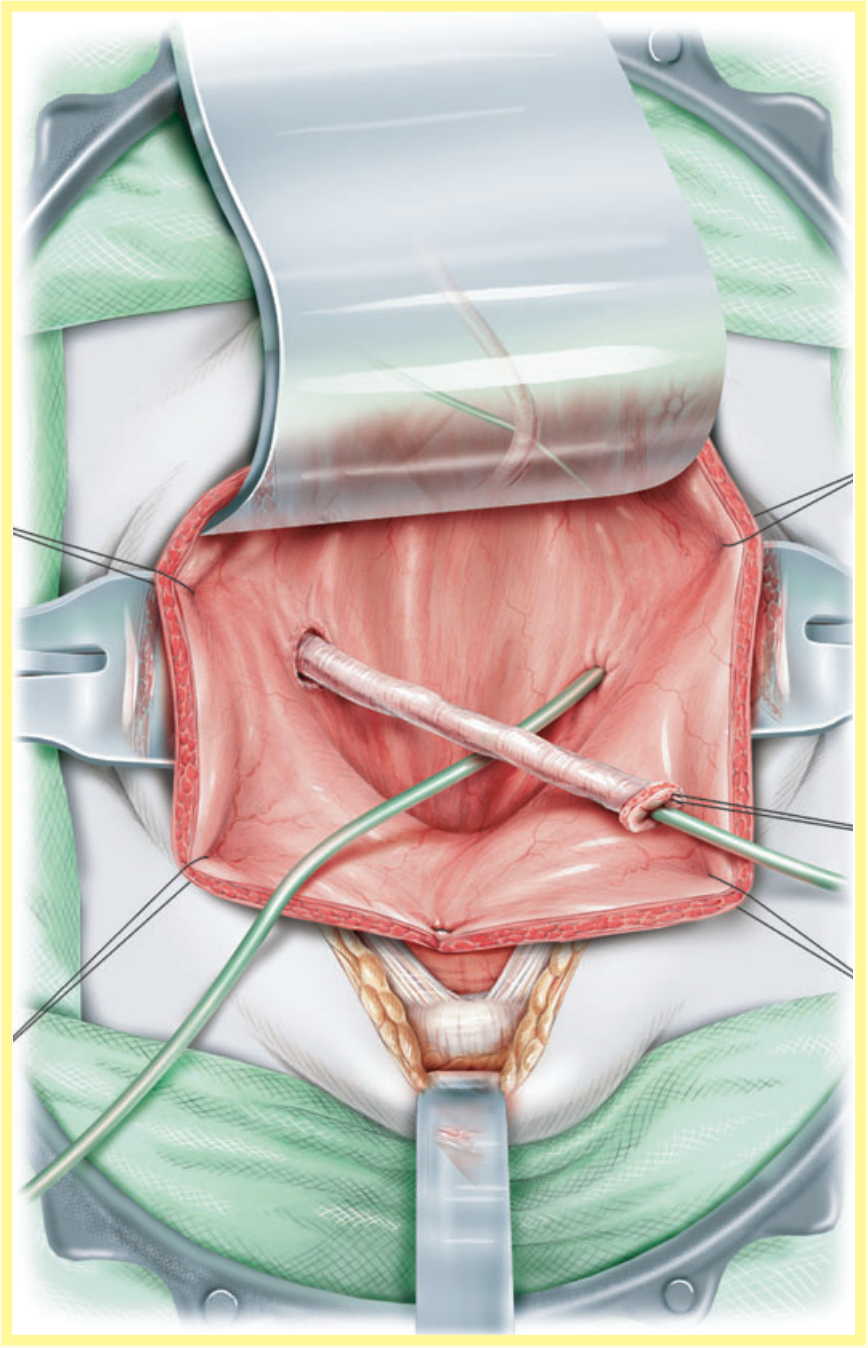
**Figure 7**

The dissection continues progressively, circumferentially until the ureter is completely freed.



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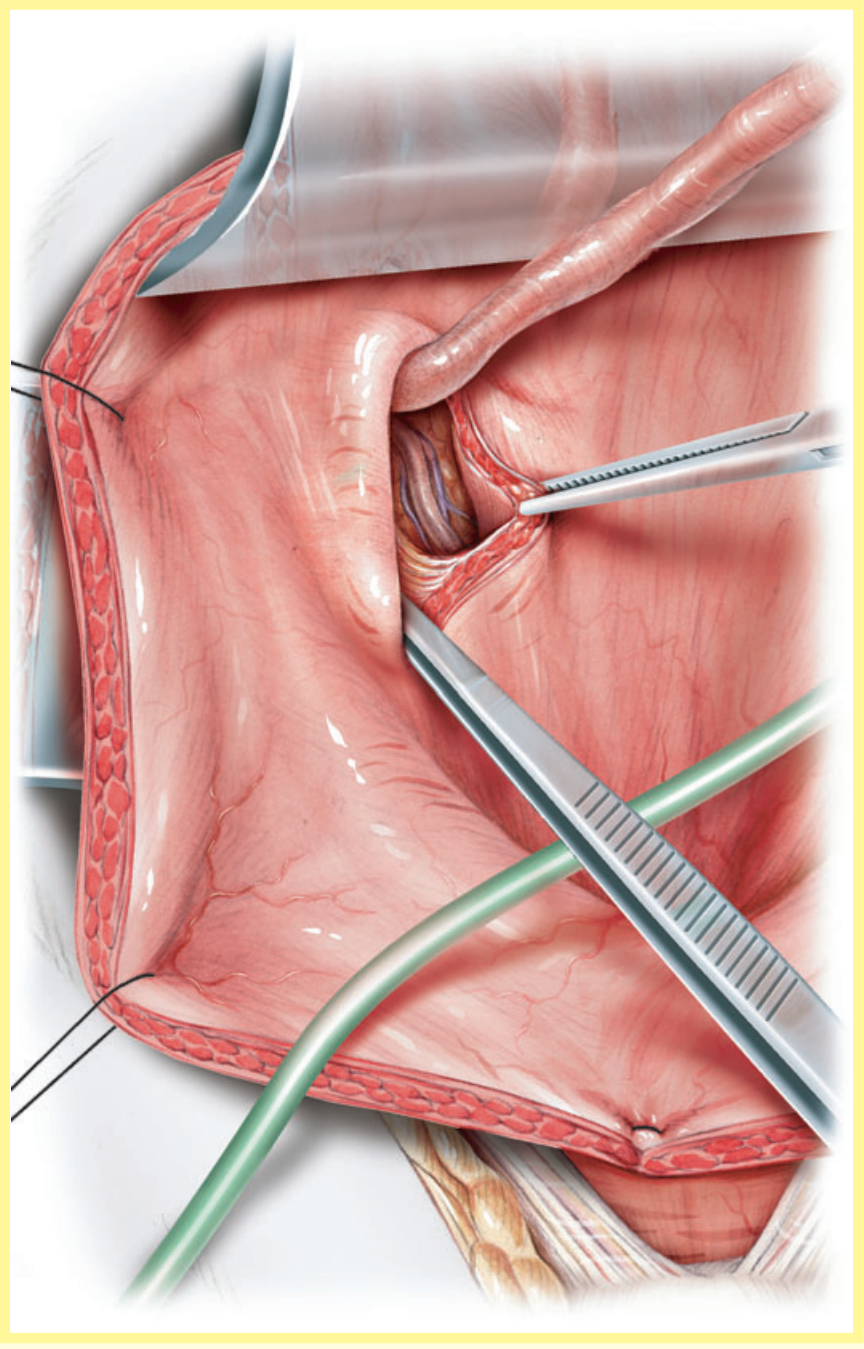

**Figure 8**

The peritoneum is visible at the end of this dissection and should be teased away from the ureter. In boys the vas deferens may lie close to the ureter at this point, and care must be taken to avoid damaging it. A similar procedure can be used for the opposite ureter. In cases of ureteric duplication, both ureters are dissected together and should not be separated, thus avoiding damage to their blood supply.

In some cases the ureteric hiatus is wide and should be narrowed by one or two absorbable sutures, to prevent the formation of a bladder diverticulum. These sutures should narrow the hiatus, but still allow the free movement of the ureter and not restrict or constrict it.



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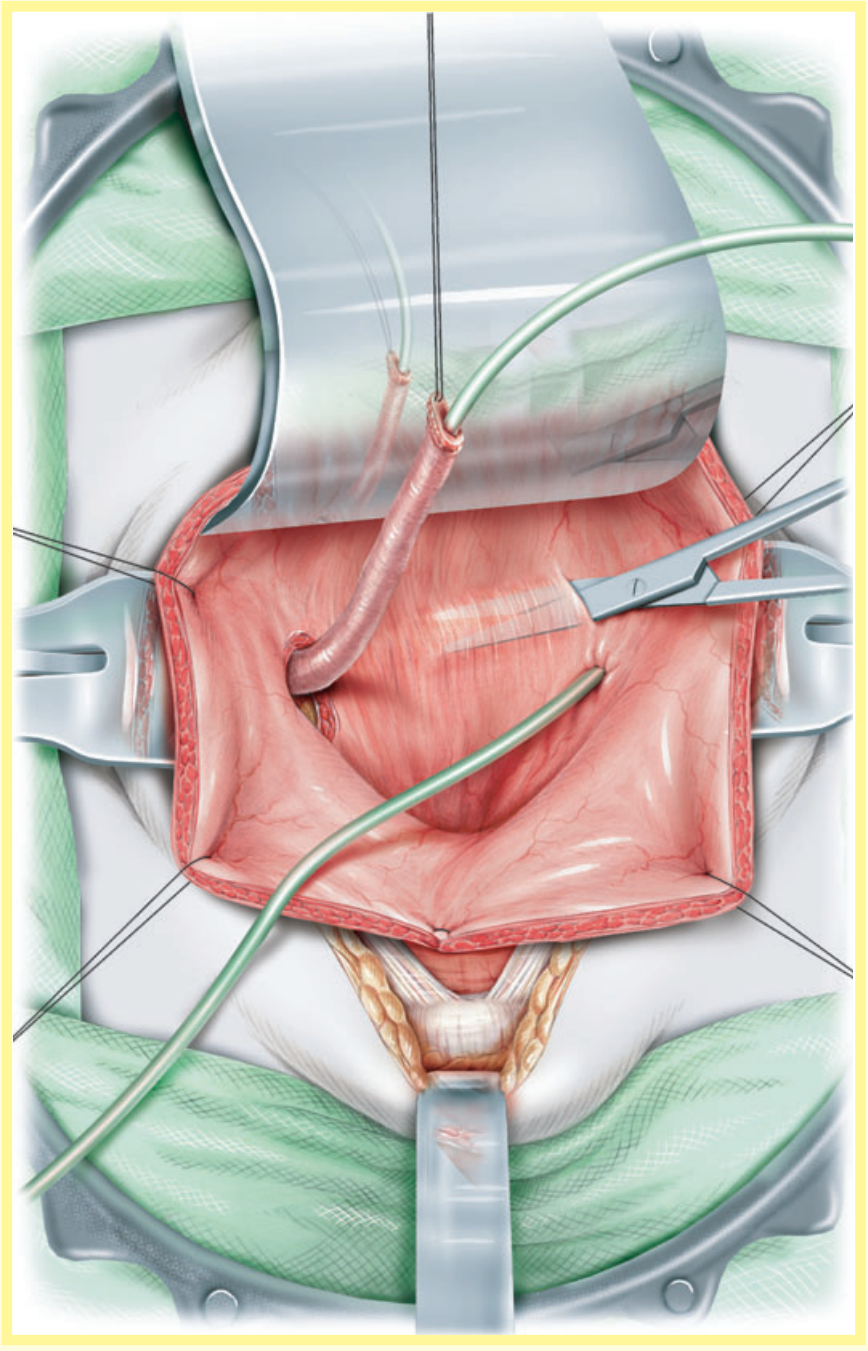
**Figure 9**

The submucosal tunnel is then formed; it is usually a horizontal tunnel, crossing the midline of the posterior surface of the bladder, just above the trigone.



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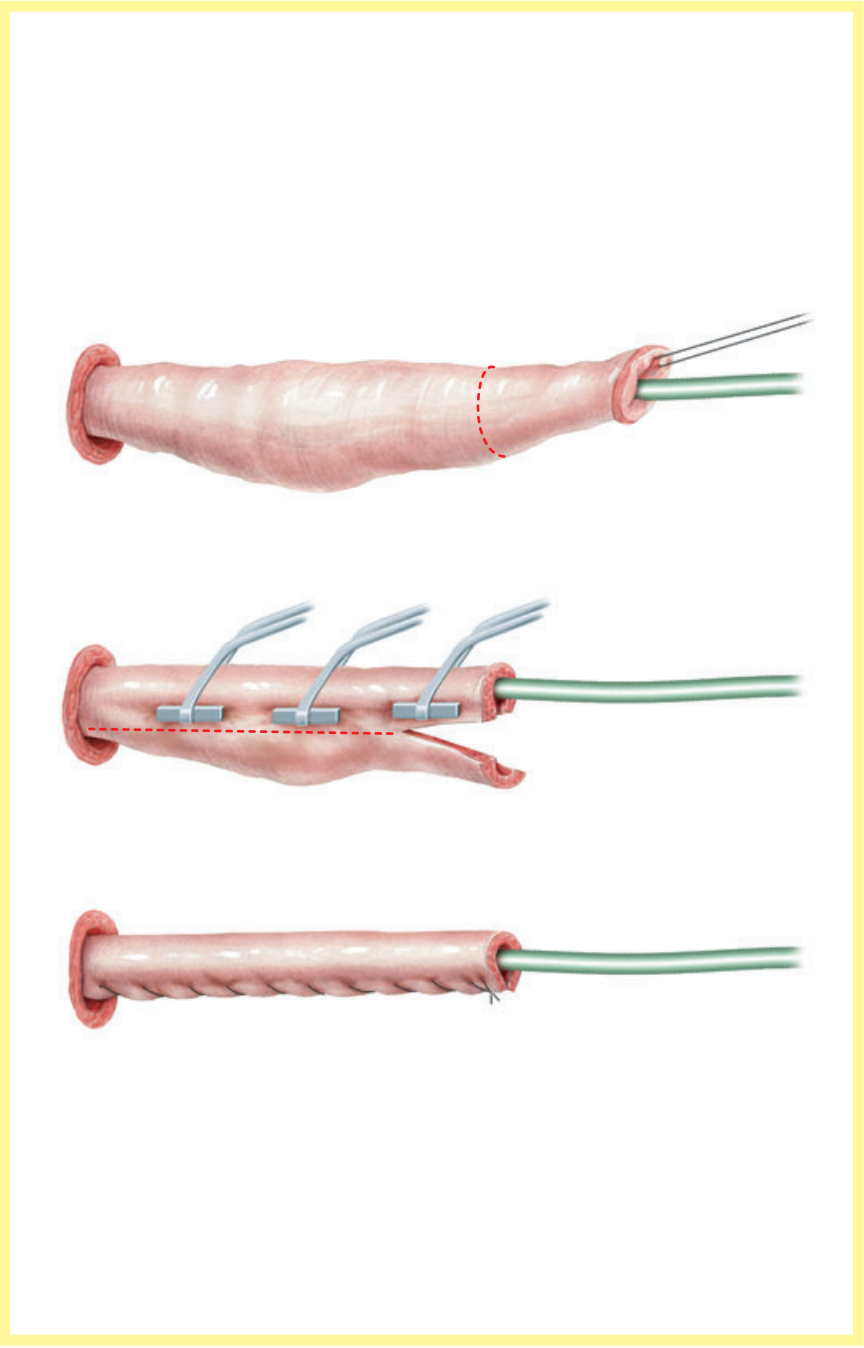

**Figure 10**

The length of the submucosal tunnel should be at least five times the ureteric diameter (Paquin's rule) [7] and, if this cannot be fulfilled, modelling of the ureter should be considered. In this case, the calibre of the ureter may be reduced by excising a strip of ureter (Hendren's technique [8]).



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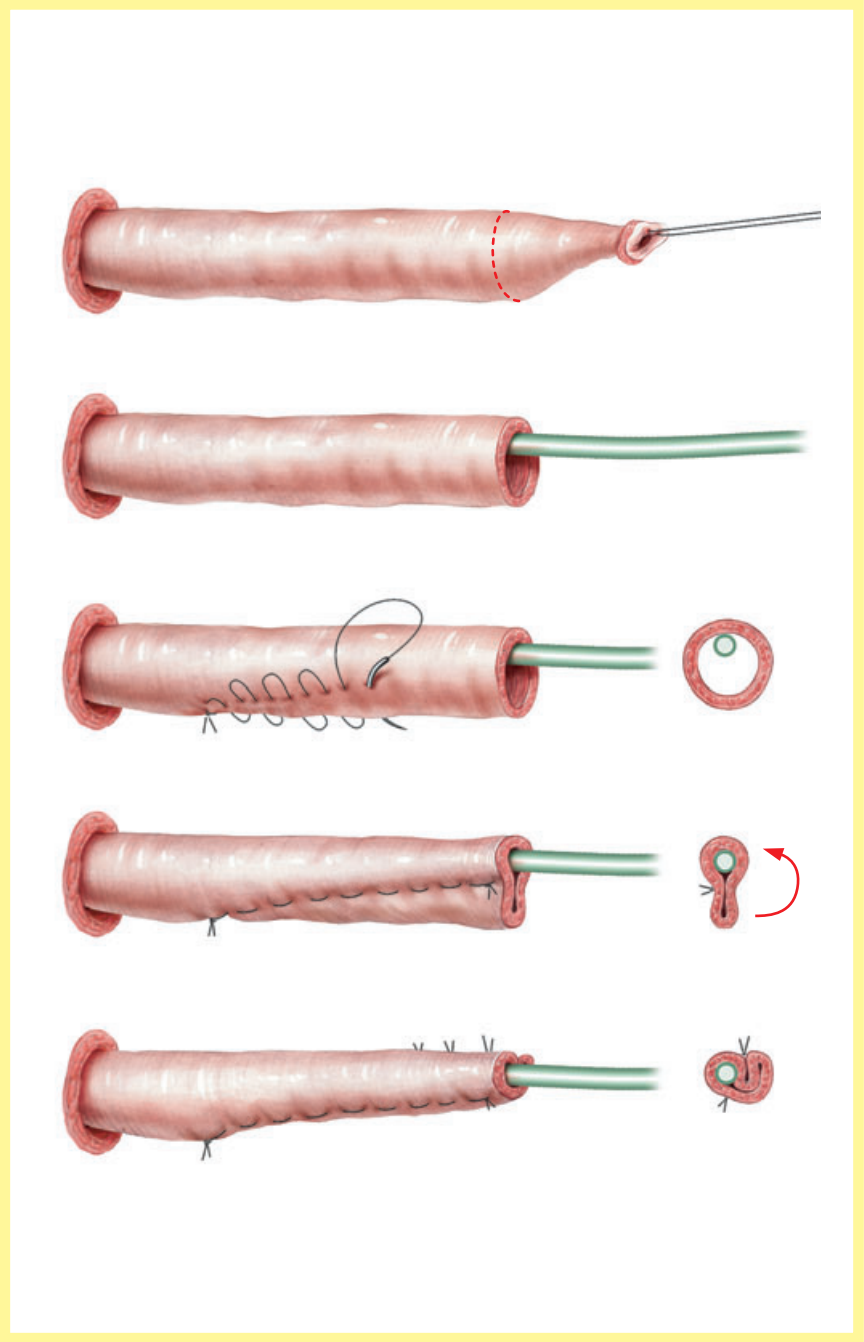
**Figure 11**

The calibre of the ureter may also be reduced by infolding the ureter (Kalicinski's technique [9]) and the length of the modelled segment should not exceed the length of the submucosal tunnel.



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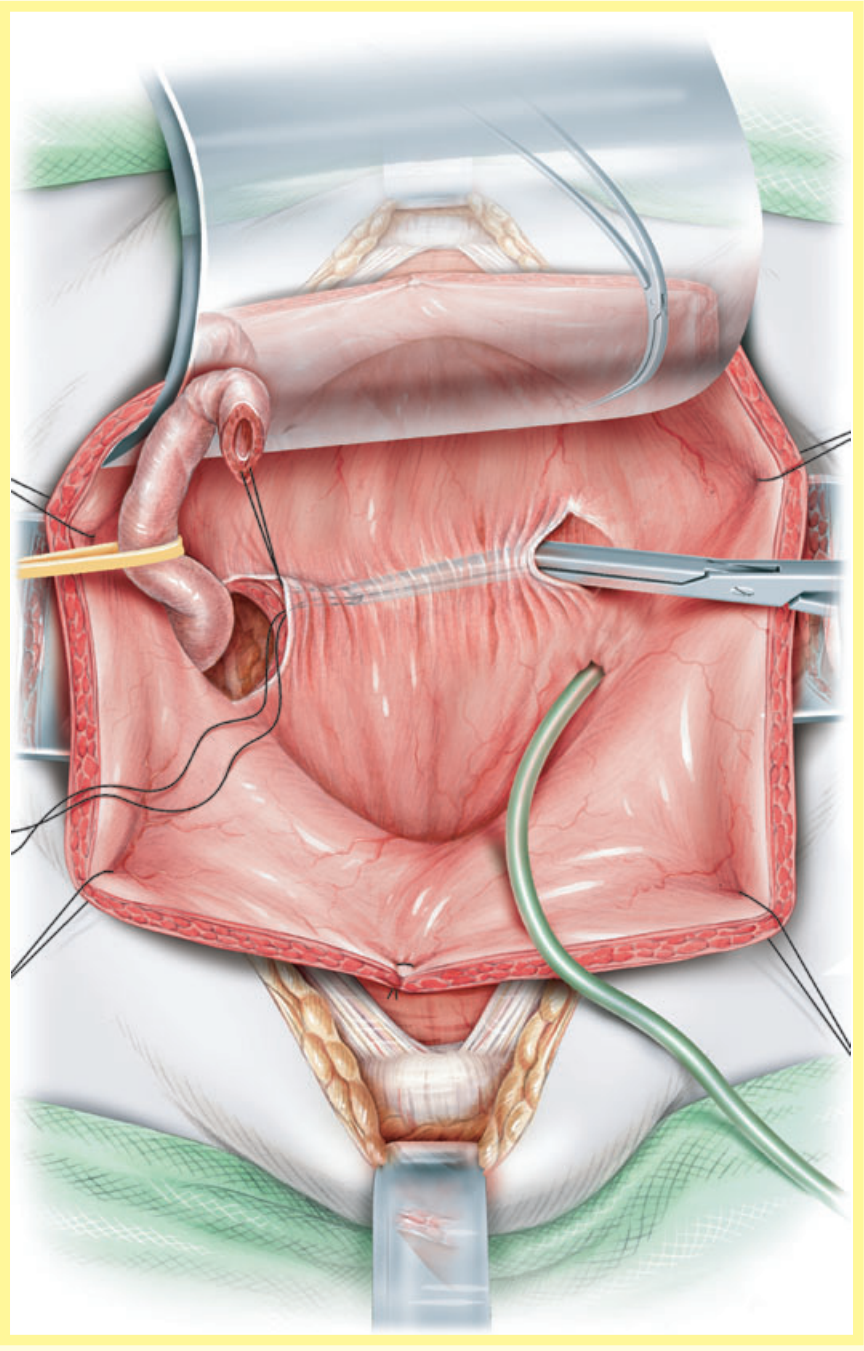

**Figure 12**

The site of the new ureteric orifice is selected and the bladder mucosa lifted from the underlying bladder muscles with a pair of Reynolds scissors, starting either from the hiatus or from the new ureteric orifice. Again, sharp scissors should be avoided; Reynolds scissors are ideal because their tips are blunt. The tunnel should be wide enough to allow easy insertion of the ureter, with no constriction.

A similar procedure can be used for the opposite ureter in case of bilateral reimplantation. The construction of the lowest tunnel which crosses the trigone can cause slight bleeding, and lifting the mucosa is slightly less easy.

A pair of artery forceps or a right-angle is inserted through the tunnel, the stay suture grasped and gently pulled to draw the ureter into place, taking care not to twist or kink it.



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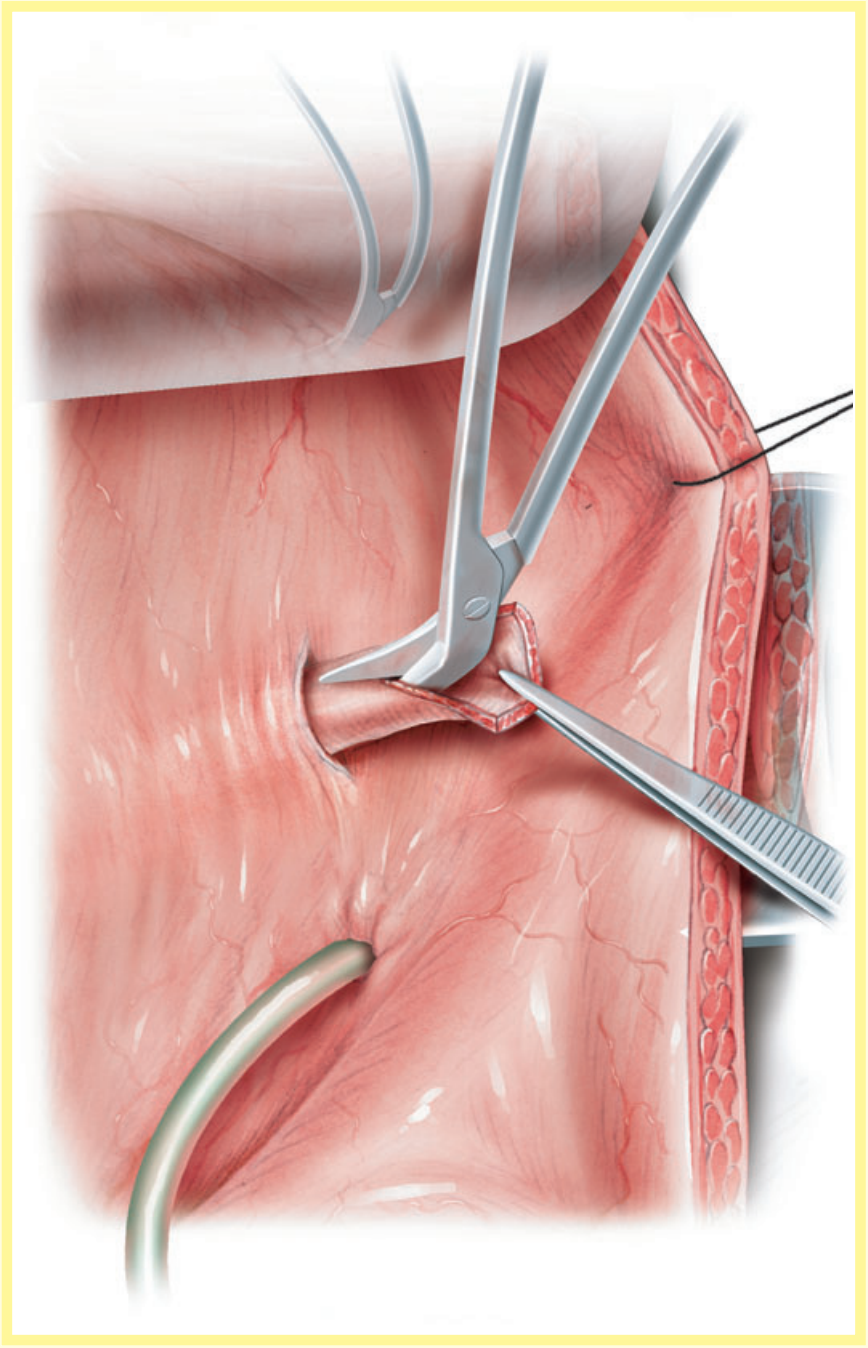
**Figure 13**

The last 2 cm of ureter is excised and the ureteric opening spatulated with a pair of angled Potts scissors.



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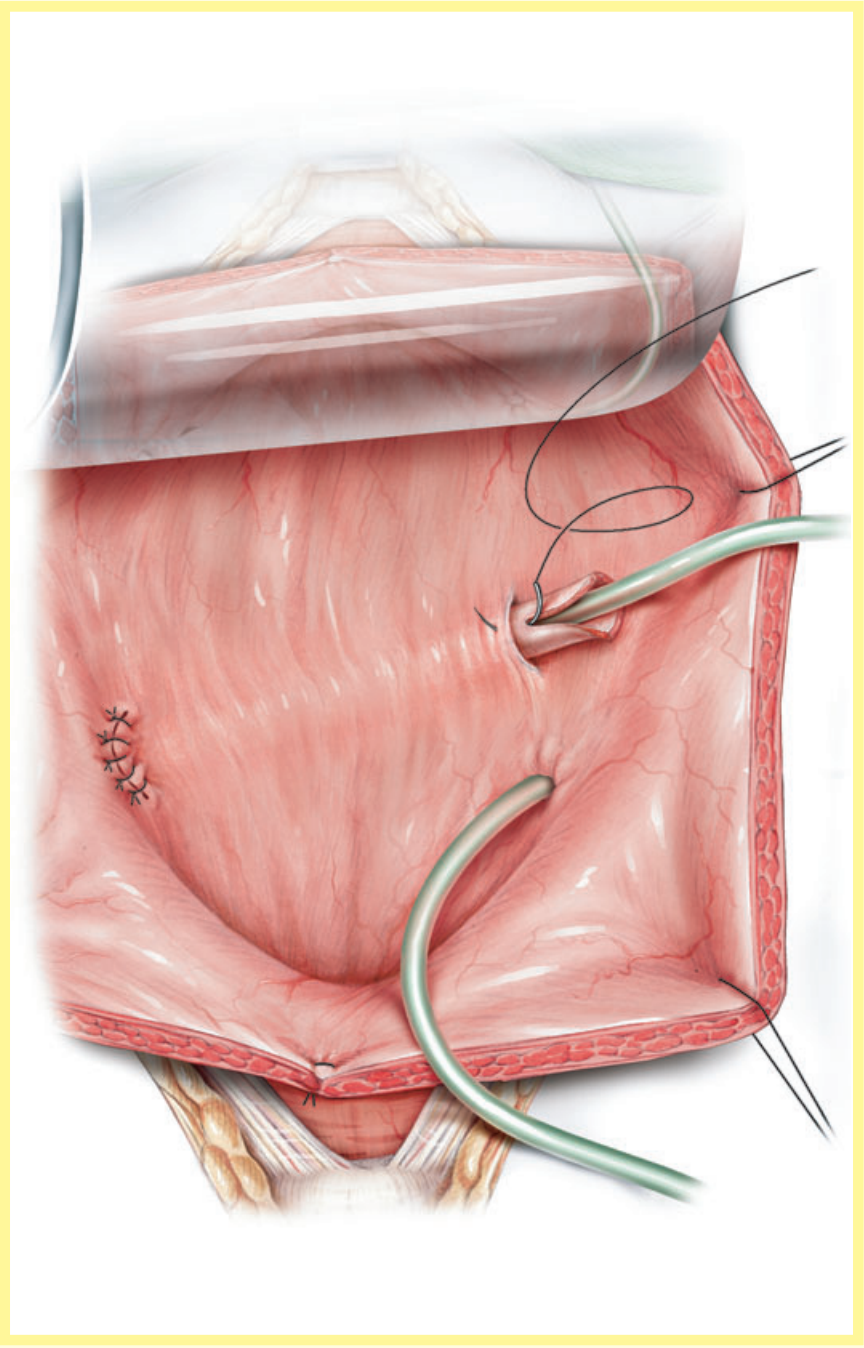

**Figures 14 and 15**

The 5/0 absorbable suture anchors the ureter to the bladder muscles and the ureterovesicostomy is completed with interrupted 6/0 absorbable sutures.



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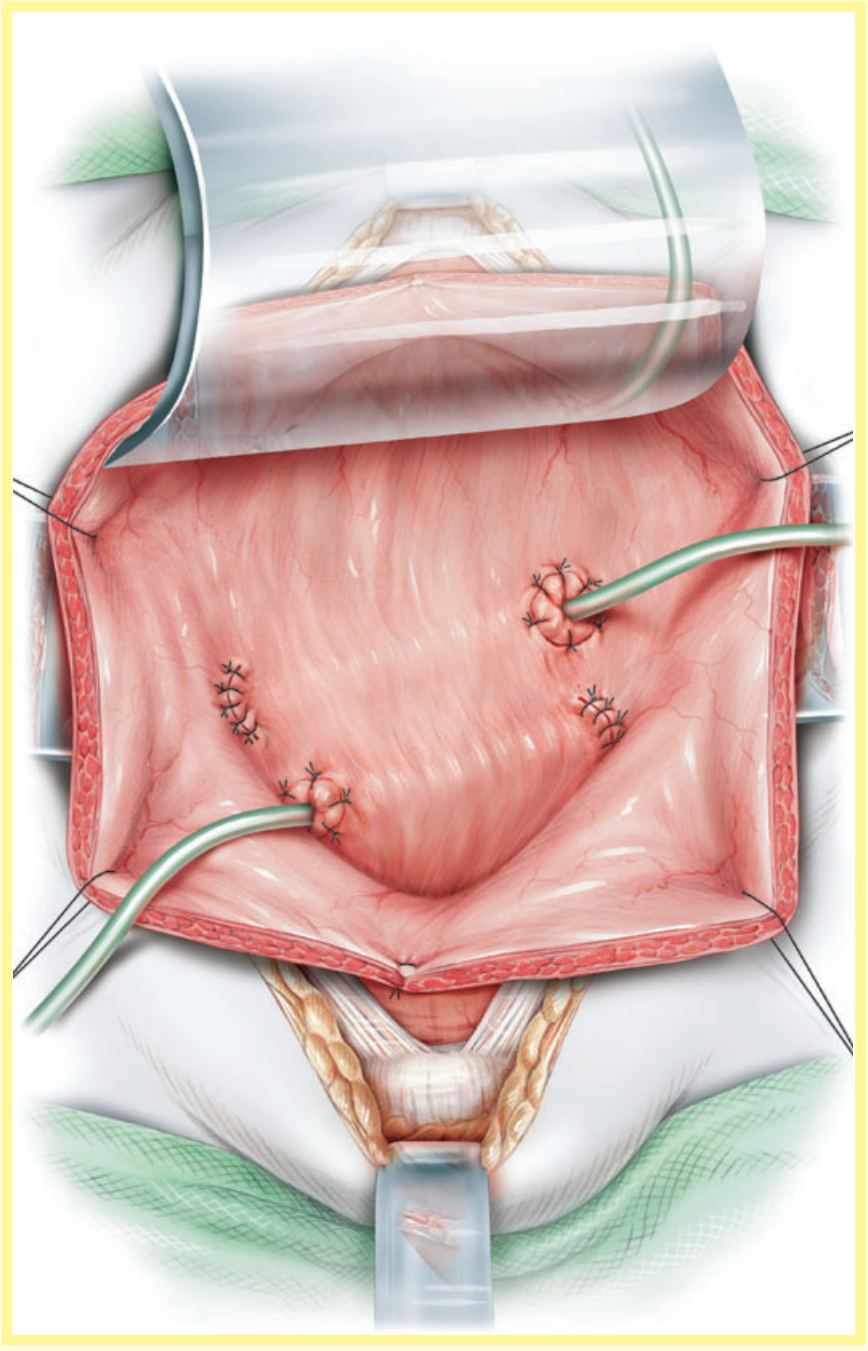
Figure 15



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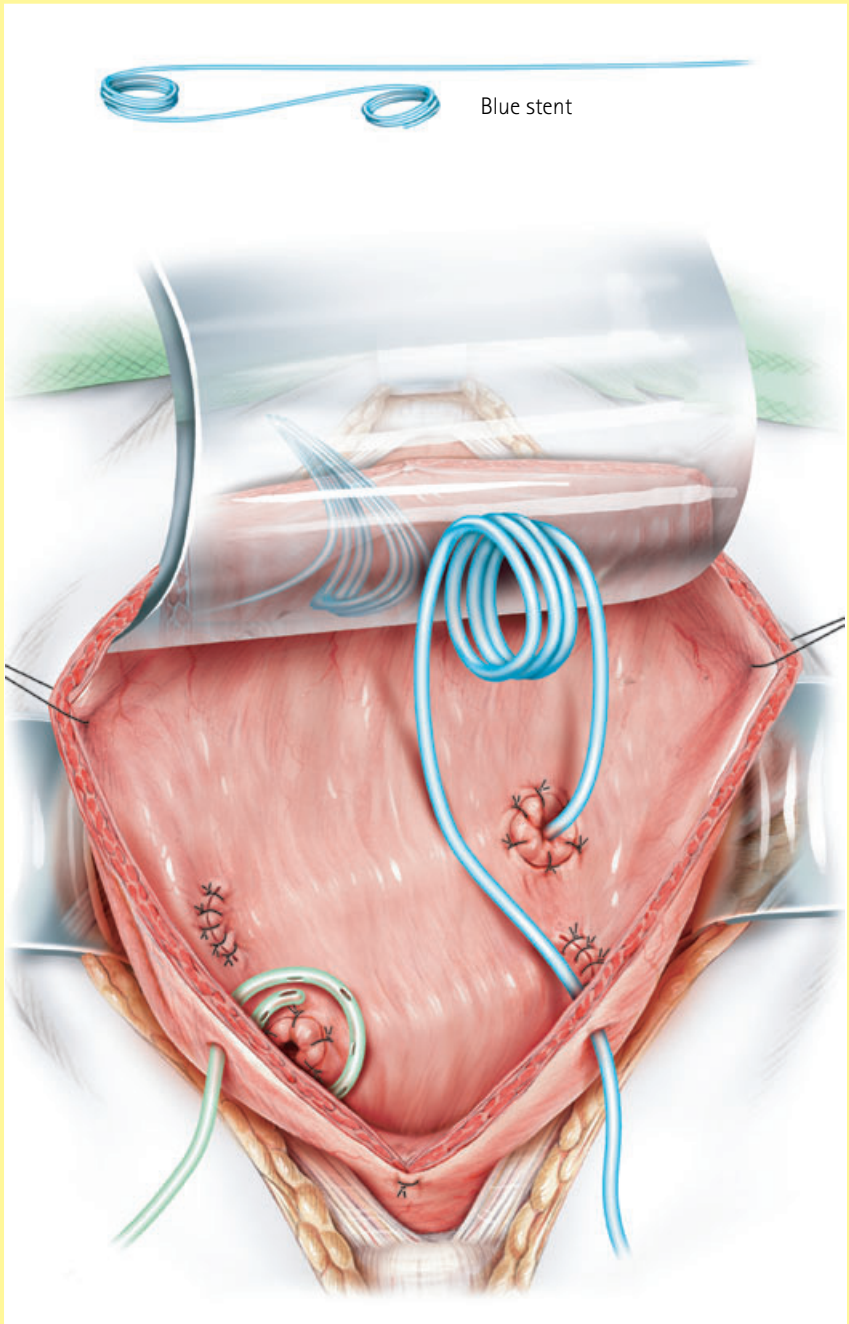


**Figure 16**

For some surgeons, an infant feeding tube or JJ stent or 'Blue Stent' is inserted into the reimplanted ureter and exteriorized through the bladder wall, the rectus muscle and the skin, using the punch of a suprapubic catheter. The feeding tube is left in position for 2 days, or for 10 days if the ureter has been re-modelled. There is no consensus on the efficacy of drainage of the reimplanted ureter and some authors do not leave any drainage. The bladder is drained either by a transurethral catheter for 5 days or by a suprapubic catheter.



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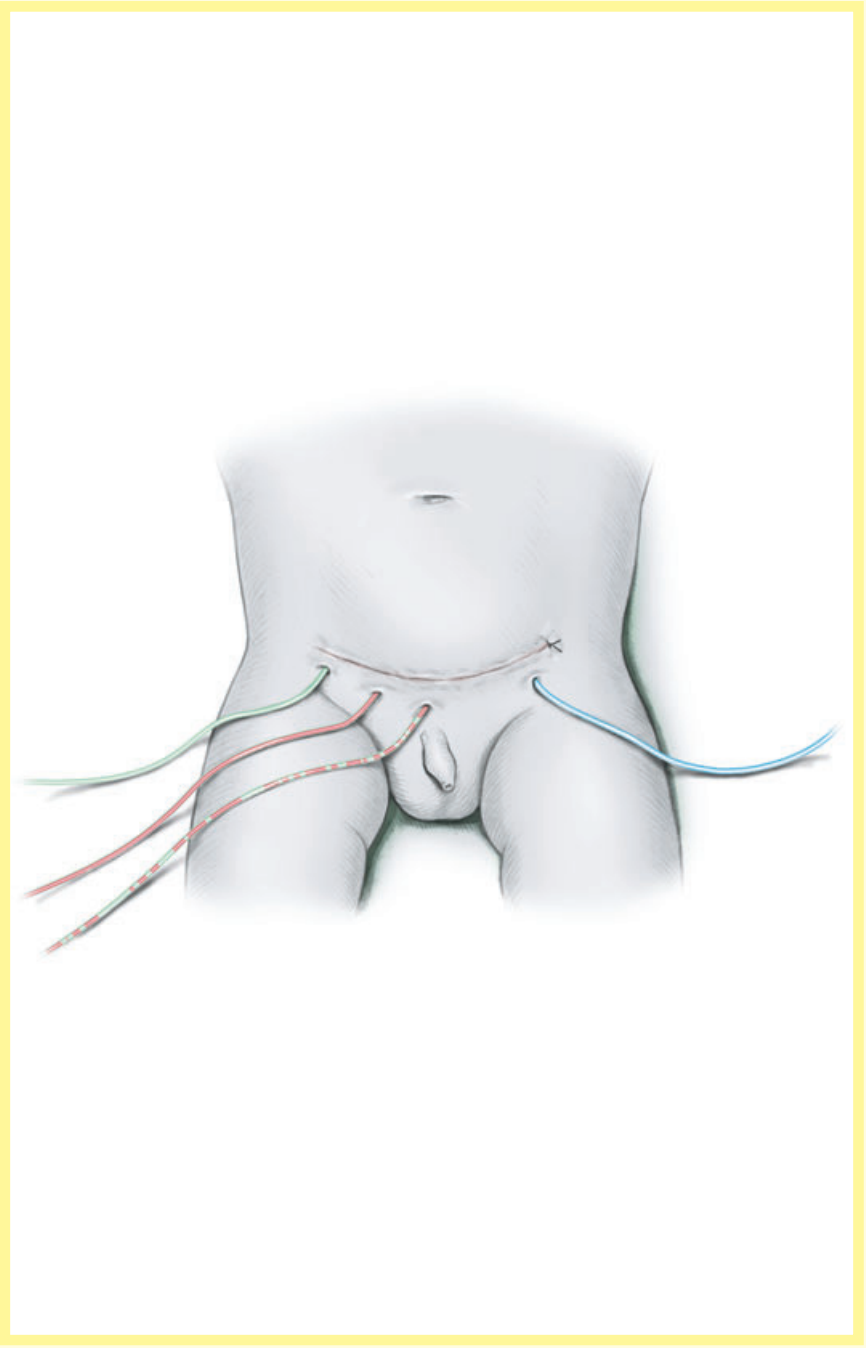
**Figure 17**

The bladder is closed with a 3/0 or 4/0 suture (interrupted or continuous). The pre-vesical and subcutaneous spaces are drained by a suction drain. The abdominal wall, the subcutaneous tissues and the skin are then closed.



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## POSTOPERATIVE CARE

The child is usually hospitalized for 5 days; the ureteric stent is removed after 2 days (or 10 days if the ureter has been re-modelled). The bladder catheter is removed at 5 days. Both suction drains are usually removed on the second day. Bladder spasms are common and oral oxybutynin can be useful to reduce the discomfort. The type of antibiotic prophylaxis varies widely among surgical teams. Pain is controlled with diclofenac suppositories.

The child should stay away from school for 2 weeks after surgery and avoid sport for 1 month. Ultrasonography is usually advisable 3 months after surgery to ensure that there is no increased dilatation of the upper tract which could be related to a ureteric obstruction at the level of the reimplantation. For some patients, a MAG-3 scan with indirect cystography is repeated 6 months after surgery to ensure that the drainage is correct and reflux no longer detectable. The same procedure can be done laparoscopically [10] but this method needs a formal long-term evaluation.

These procedures only aim to stop VUR; their effects on renal damage and on the recurrence of UTIs are questionable.

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