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Surgery Illustrated – Surgical Atlas
Ileal neobladder

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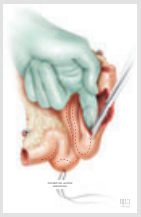
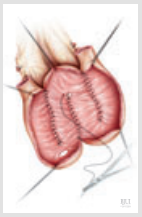

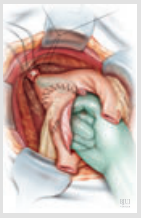
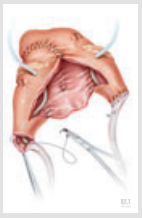

INTRODUCTION

During the past 20 years orthotopic reconstruction has developed from 'experimental surgery' to 'standard of care at medical centres', and to the 'preferred method of urinary diversion' in both sexes. The ileal conduit first described in 1950 remains the standard for urinary diversion against which others must be judged. During the last decade the use of the time-honoured conduit has given way to the increasingly frequent use of orthotopic reconstruction [1,2].

PLANNING AND PREPARATION

PATIENT SELECTION

Any patient who requires urinary diversion is a candidate for this procedure. The most important factor that will determine a successful outcome of bladder substitution is the willingness of the patient to cope with indefinite follow-up. Adequate physical dexterity and a basic comprehension of the neobladder and how it functions are required. Continuing education is essential for the longevity of the patient and the neobladder. If this cannot be guaranteed, an alternative form of diversion should be selected. A nurse should be involved in the assessment and education before surgery and during follow-up.

RENAL FUNCTION

The metabolic defects seen after urinary diversion are acidosis, followed by electrolyte abnormalities. The type and severity of abnormalities encountered depend on the gut segment itself, length of segment used, time

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of urine contact with the segment and the functional reserve of the kidneys. A serum creatinine level of 150 μm/L is required.

HEPATIC FUNCTION

Sufficient liver function is needed in neobladder candidates. The reservoir comes into contact with urine where ammonium enters the circulation via the bowel mucosa. In a UTI with a urease-splitting organism, the ammonium load becomes critical. In the presence of liver insufficiency, this results in hyperammonaemia. This phenomenon can lead to neurological decompensation and eventual coma [3].

BOWEL FUNCTION

Evidence of previous bowel resection, disease or radiotherapy must be considered to prevent malabsorption or diarrhoea if further bowel resection is necessary. The bowel segment used for a neobladder needs to be free of disease. An intact ileocaecal valve might compensate for a shortened ileum that otherwise would lead to insufficiency. Every attempt should be made to preserve as much of the terminal ileum, as this minimizes the risk of bowel dysfunction, and interference with vitamin B12 and bile salt metabolism. Ileal segments of up to 60 cm can be used in healthy individuals without sequelae if the ileocaecal valve is left intact. If >60 cm of bowel is used for the reconstruction, the risk of malabsorption increases. This is inevitable if >100 cm is used [4].

PROSTATIC URETHRA AND BLADDER NECK BIOPSY

A positive biopsy from the prostatic urethra, or the bladder neck in women, indicates a higher likelihood of urethral recurrence. These patients preferably should undergo primary urethrectomy and be considered for an alternative form of diversion.

Patients with prostatic infiltration (superficial or stromal) proximal from the verumontanum, carcinoma *in situ*, and/or multifocal TCC in the bladder have a higher chance of urethral recurrence. However, these conditions are not contraindications for a neobladder. The final decision rests on the result of the frozen-section analysis obtained from the resection margin at the time of radical cystectomy (RC).

CONTINENCE

Preoperative incontinence, especially in females, is critical, as it might reflect inadequate sphincter function. Severe incontinence is a contraindication to bladder substitution.

SPECIFIC PATIENT PREPARATION

BEFORE SURGERY

Because ileum is used no specific preparation is necessary. Mechanical and antibacterial bowel preparation the day before surgery has been abandoned. Fasting overnight with administration of i.v. fluids to provide good hydration is required. Patients with a history of thromboembolic disease or varicose veins should receive a prophylactic dose of heparin the evening before surgery and every 12 h thereafter until ambulation. Compression leg stockings are advised. A parenteral broad-spectrum antibiotic is given before the induction of anaesthesia and continued after surgery for ≥3 days [4].

SPECIFIC PATIENT POSITIONING

The patient is placed in a hyperextended supine position with the superior iliac crest located at the fulcrum of the operating table. The legs are slightly abducted so that the heels are positioned near the corner of the foot of the table. For orthotopic diversion in the female patient, the modified frog-leg or lithotomy position is used, thus allowing access to the vagina. A reverse Trendelenburg position levels the abdomen parallel with the floor and helps to keep the small bowel contents in the epigastrium. A nasogastric tube is placed, and the patient is prepared from nipples to mid-thighs. In the female patient, the vagina is also fully prepared and packed. After the patient is draped, a 22 F Foley catheter is placed in the bladder.

SURGICAL STEPS

Figure 1

Selection of the ileal segment

The bowel is examined and a 60-cm segment of the terminal ileum is isolated. The most dependable part of the segment should be long enough to reach the top of the symphysis pubis at skin level. Mark that point with a suture. This manoeuvre guarantees that the reservoir later reaches the urethral remnant with no difficulty. Back-light transillumination of the mesenteric attachment greatly helps in identifying the arterial arcades supplying the selected segment. The bowel is divided 20–25 cm proximal to the ileocaecal valve in the avascular window of Treves, between the ileocolic artery and the terminal branch of the superior mesenteric artery. The ileum is divided proximally in a suitable avascular plane between the superior mesenteric arcades. Continuity of the bowel is re-established by end-to-end anastomosis. The use of an automatic stapler or hand-sewn technique is a matter of surgeon's preference.

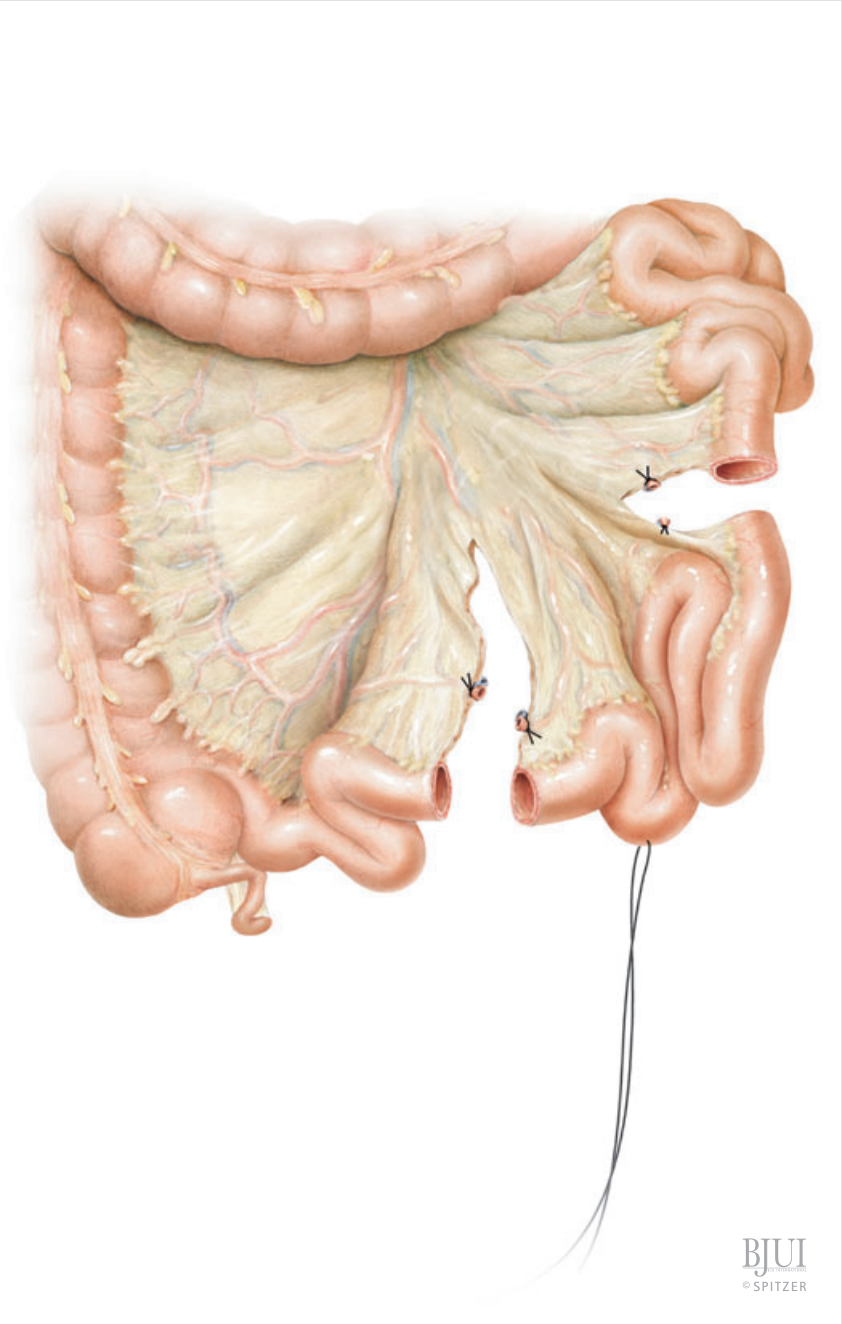


Figure 2

The isolated bowel segment is thoroughly cleaned and rinsed with saline or an iodine solution. With the exception of the 2–3 cm short chimneys on both sides of the 'W' and the intended site of the ileo-urethral anastomosis previously marked with a suture, an antimesenteric incision of the ileum is carried out (interrupted line).

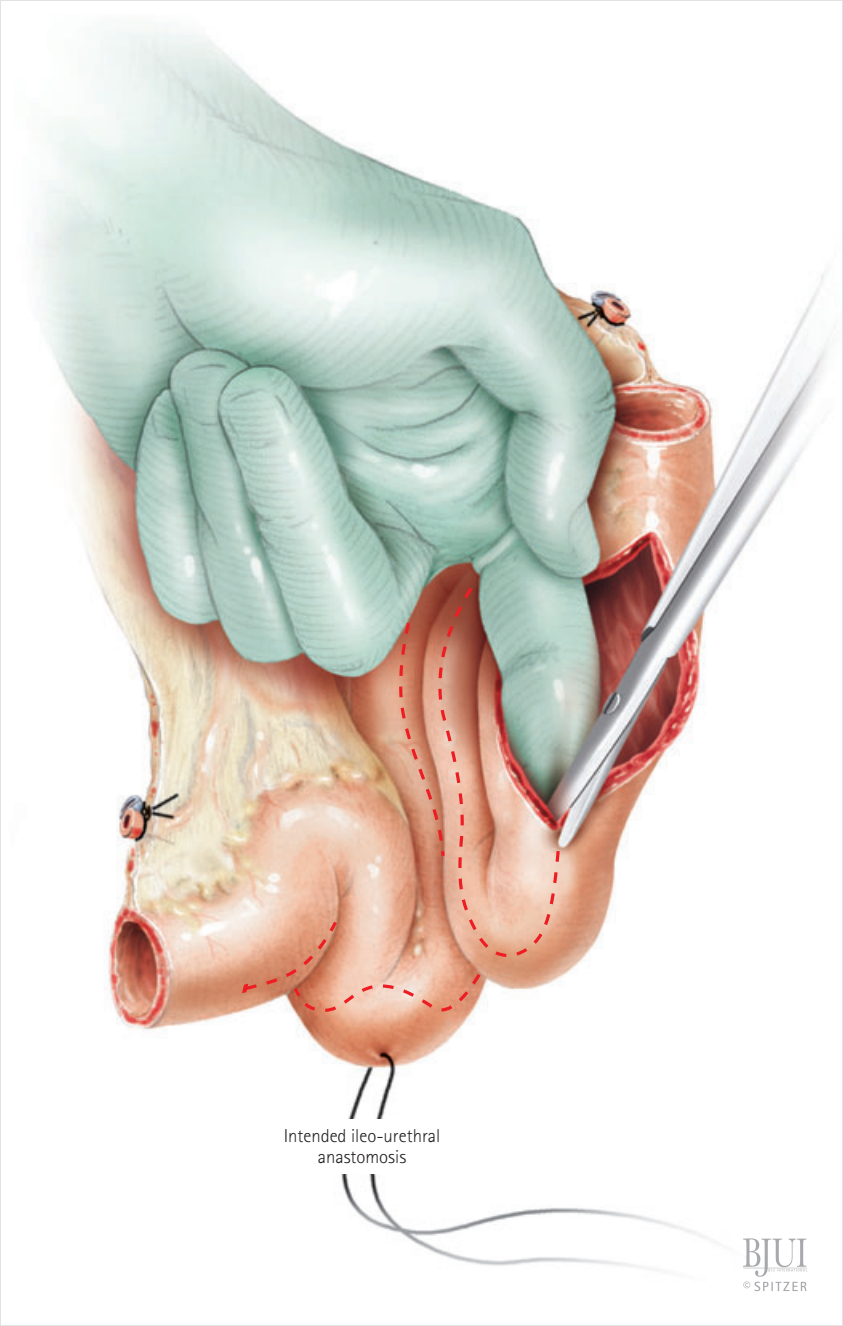


Figure 3

Construction of the reservoir

Apart from the two chimneys, and a 6–7 cm section centred around the marking suture, which is opened close to the mesenteric border to create a U-shaped flap for the ileo-urethral anastomosis, the bowel has been opened antimesenterically. Four lengths of ileum are arranged in the shape of a 'W' with 2–3 cm-long chimneys on each side of the 'W' using five to six traction sutures. These are placed medial to the chimneys on the top of the ileal plate and at the four corners of the ileal plate. These sutures can be moved several times if necessary and allow the plate to be manipulated into the desired shape. Pulling on these sutures moves the neobladder like a 'jumping jack' and allows any desired adjustments. For example, the bridge between the chimneys should be at least 7–8 cm to guarantee that they sit far laterally after the reservoir has been closed and do not obstruct the sigmoid. A buttonhole of all layers is excised from the ileal plate 2–3 cm from the tip of the U-shaped flap. An ileal plate is formed from the 'W' by sewing together the cut edges of the antimesenteric borders using 2–0 synthetic absorbable suture (SAS) on a straight needle.

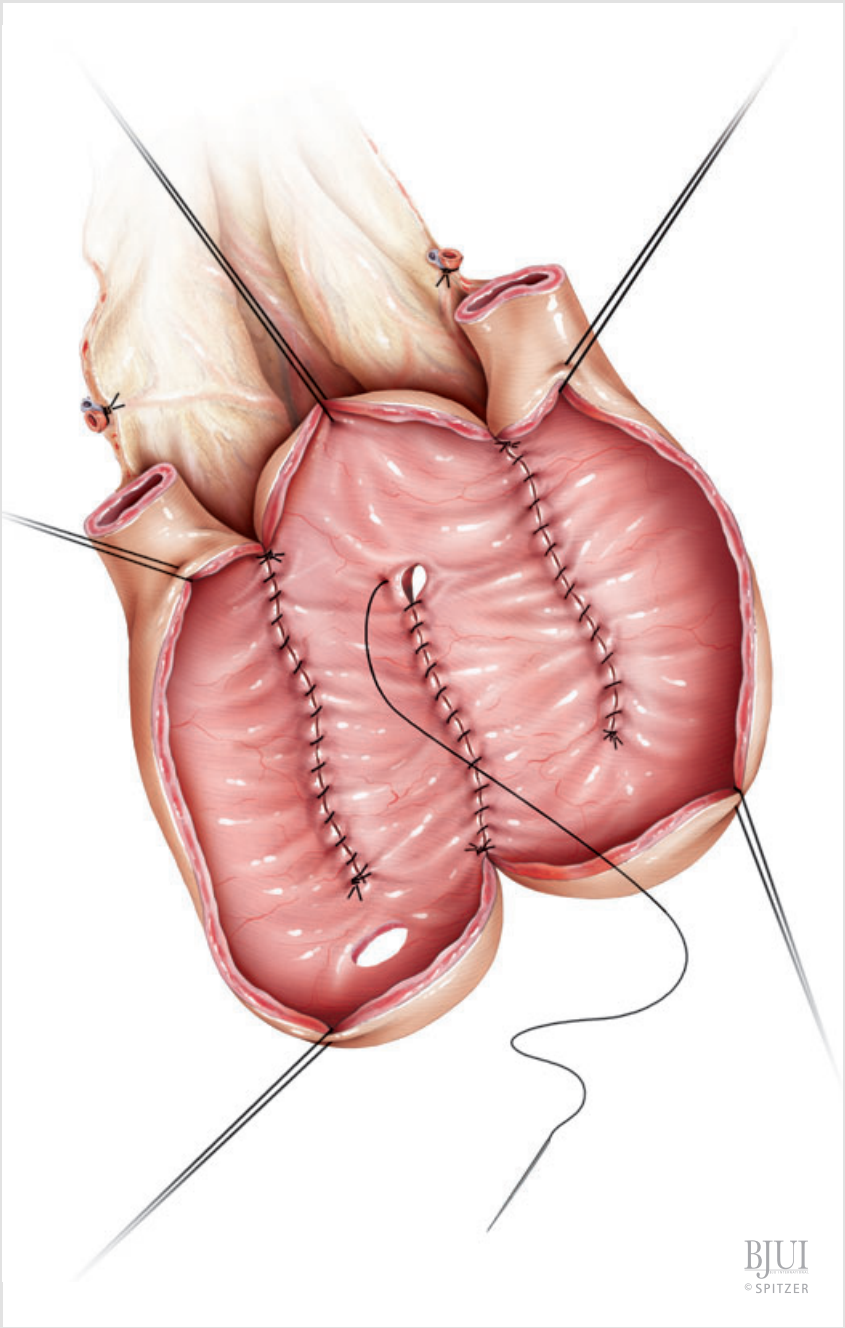


Figure 4

Ileo-urethral anastomosis

The urethral remnant should be approached and prepared exactly as is done in nerve-sparing radical prostatectomy. A 22 F catheter is placed through the buttonhole of the ileal plate. For the actual anastomosis, six previously placed double-armed sutures using 3–0 SAS in the urethra are used. The inner sutures are passed through the neobladder outlet in the ileal plate without grasping the ileum, and the corresponding outer sutures grasp the entire ileal wall 5–8 mm lateral to the neobladder outlet. This guarantees a wide, ideal, funnel-shaped anastomosis with the mucosa in direct contact with urethral epithelium. Next, under gentle traction on the transurethral catheter, the ileal plate is manipulated down to the urethral remnant, and the knots are tied inside the reservoir.

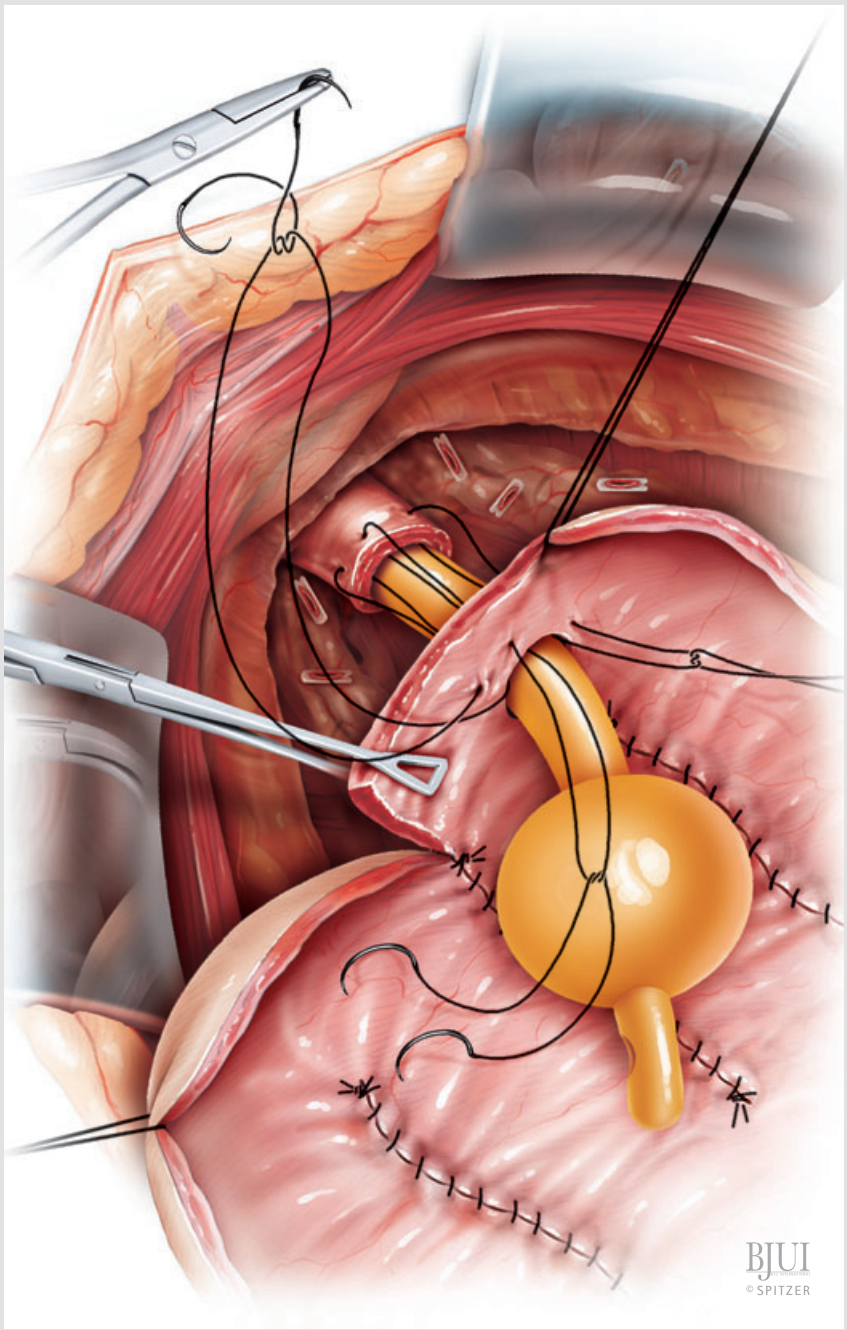


Figure 5

Ileo-urethral anastomosis

Many surgeons prefer to close the lower third of the anterior wall of the neobladder as shown in Fig. 5. This facilitates pushing the reservoir down to the urethra with the index finger and avoids traction on the tied sutures.

Alternatively, the ileo-urethral anastomosis can be made from outside the reservoir, similar to the method used in radical prostatectomy.

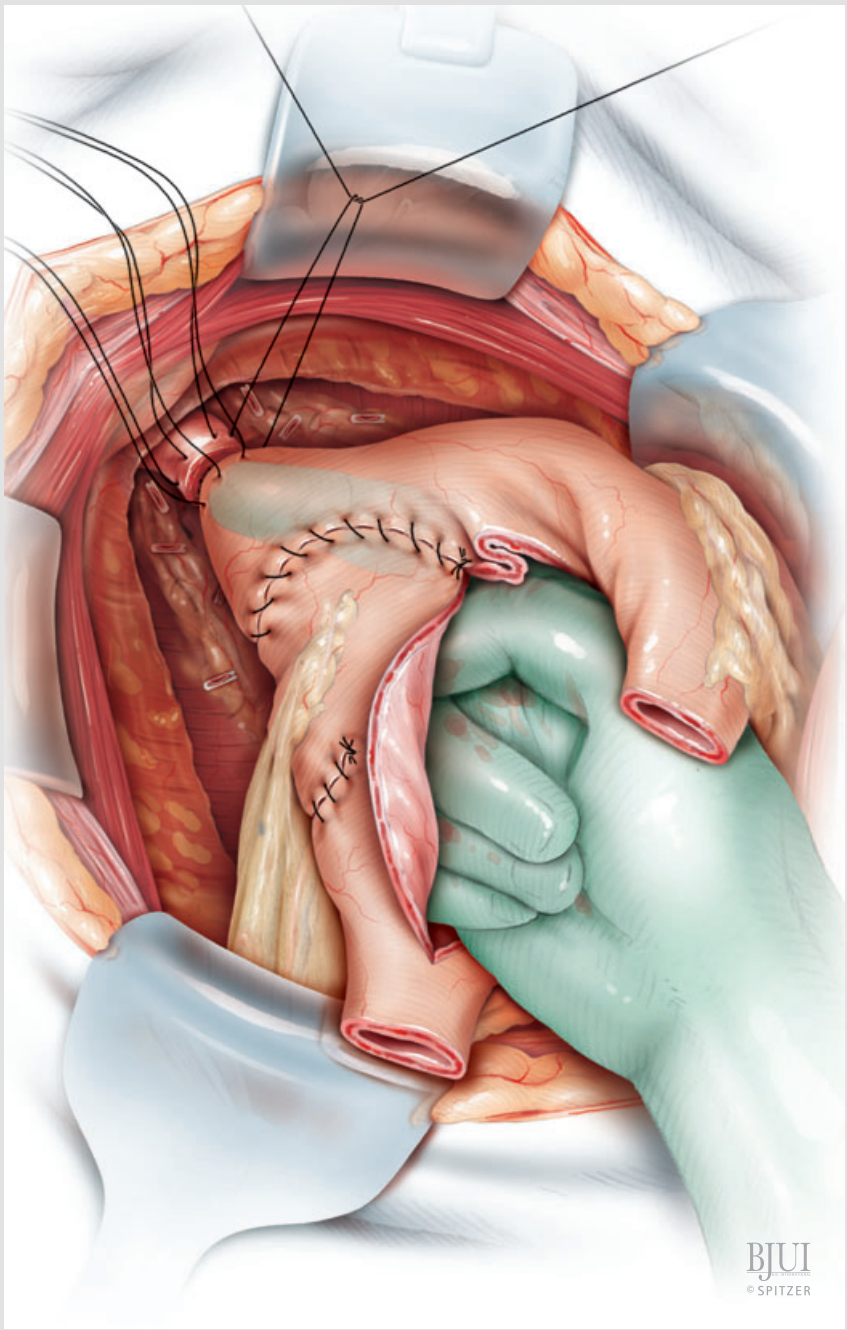


Figure 6

Uretero-ileal anastomosis

The ureters are split over 1.5–2 cm and anastomosed to the chimneys by two running sutures, by the Wallace technique in an open end-to-side fashion. The ureters are stented with 7 or 8 F catheters. To prevent dislocation of the splints, an absorbable suture (4–0 polyglycolic acid) is placed through the ureter and bladder wall 1 cm away from the anastomosis. It is tied loosely and subsequently fixes the stent. The most distal peri-ureteric tissue is sutured to the chimney to remove tension on the anastomosis and to cover it. The ureteric stents are passed through the anterior wall of the neobladder. The ileo-ureteric anastomosis an be made after the reservoir has been fixed to the urethra. However, this is easier to do before ileo-urethrostomy, although care should be taken for adequate ureteric length.

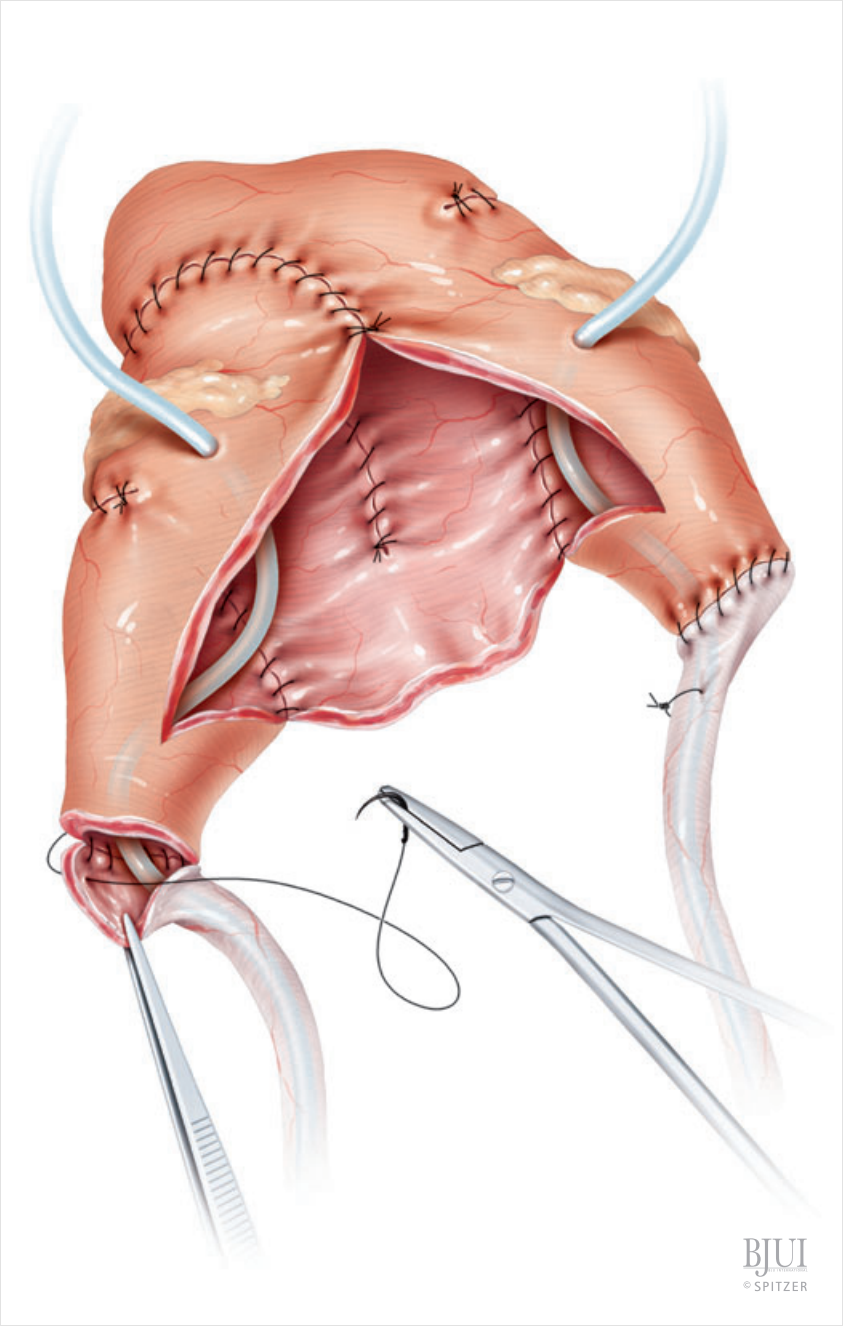


Figure 7

The neobladder replaces the bladder

The neobladder is located extraperitoneally in the small pelvis. Ileo-urethral and ileo-ureteric anastomoses are also located extraperitoneally. Depending on tumour stage and location, this goal can easily be achieved by creating two large peritoneal flaps obtained from the visceral pelvic peritoneum at the time of the preceding RC. The peritoneum over the bladder is bisected to create two large peritoneum flaps for later total extraperitonealization of the ileal neobladder. If the visceral pelvic peritoneum has to be resected, the pelvic cavity is left open. If flaps are available they are sutured to the back wall of the neobladder. Care must be taken not to compromise the neobladder pedicle.

The only difference from the native bladder (pedicles come from lateral) is that the neobladder pedicle comes from cephalad. The remaining anterior neobladder wall is closed in a T-shape with running 3–0 SAS. No cystostomy tube is placed. Two 20 F silicone drains are placed into the small pelvis.

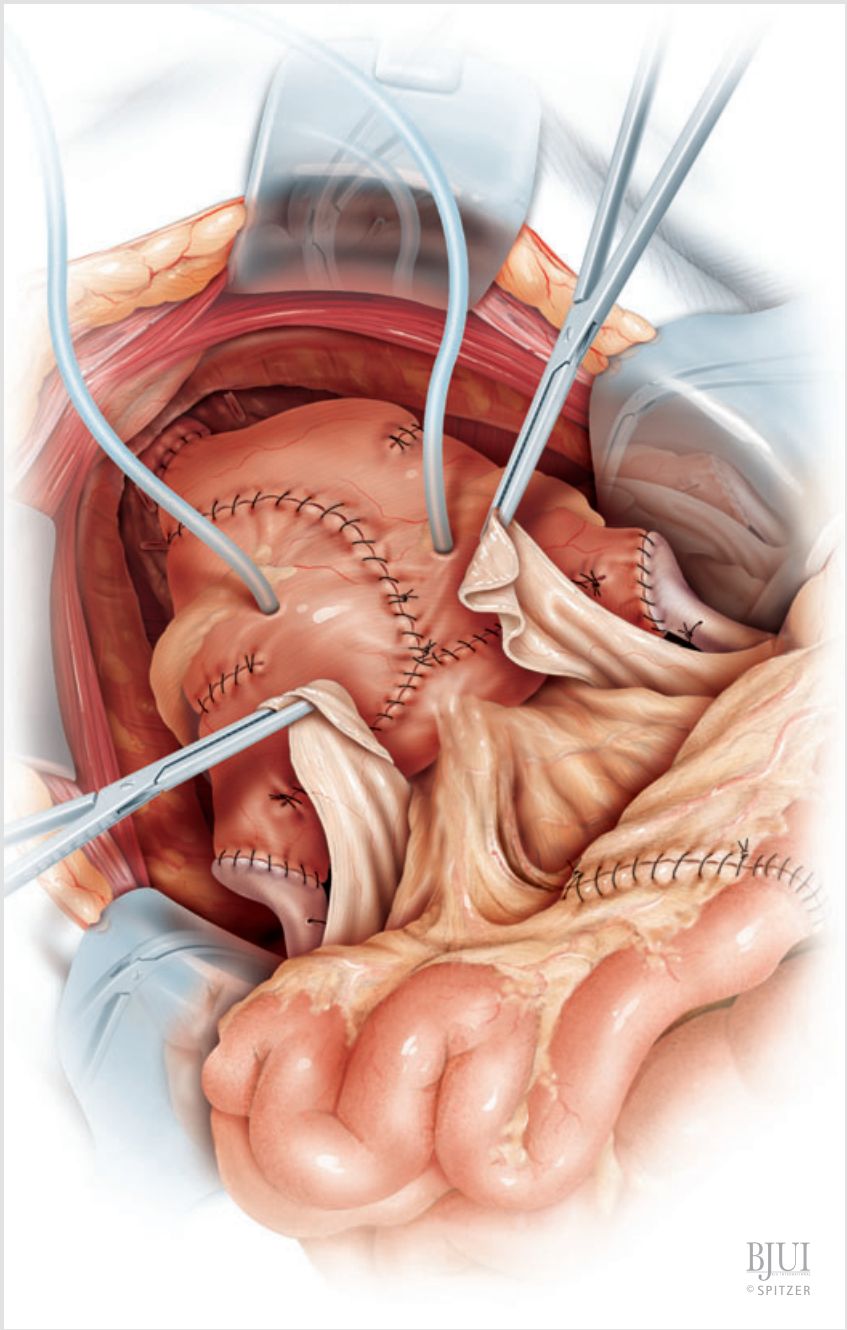
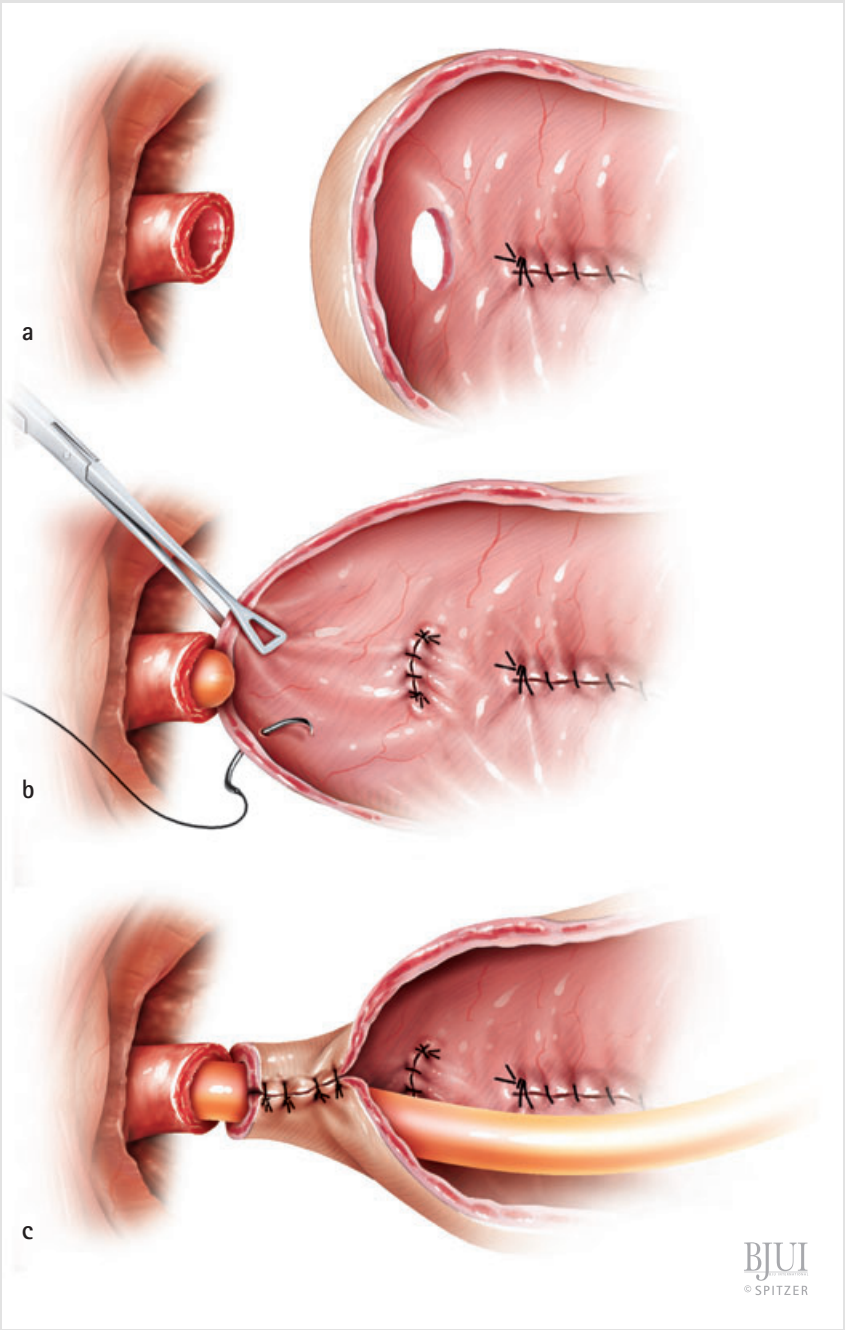


Figure 8

Performing an end-to-end anastomosis after tubularization of the U-shaped flap in the rare event that the uretero-neobladder anastomosis cannot be performed in a tension-free manner.



POSTOPERATIVE CARE

After surgery the transurethral catheter needs to be flushed with 60 mL of saline every 6 h; this is mandatory to prevent mucus blockage that can lead to neobladder rupture or extravasation of urine. The risk is highest when bowel activity returns and the catheter is still in place. The return of bowel function can be accelerated with parasympathomimetic medications (e.g. neostigmine 3–6 × 0.5 mg per cut) and in smokers with nicotine patches. The ureteric catheters should be removed 13 and 14 days after surgery, following confirmation that the ileo-ureteric anastomoses are watertight. If a cystogram at 21 days excludes any urinary extravasation, the transurethral catheter is removed. A urine sample should be sent for culture when the catheter is removed. Any UTI must be treated. A quinolone antibiotic is used as prophylaxis for 2 weeks. The patient is instructed to void while seated and to gradually extend the neobladder capacity to 500 mL, which usually guarantees continence. Voiding occurs by relaxation of the pelvic floor, followed by slight abdominal straining. This can be aided by pressure on the lower abdomen and bending forward. The effectiveness of emptying needs to be monitored with ultrasonography of the reservoir. The voiding intervals are gradually increased to 4 h. The patient must not void before the allotted time even if dribbling incontinence occurs.

The development of continence can best be understood by Laplace's law (pressure = tension/radius). Hence, as the radius of the reservoir increases the pressure in the reservoir decreases. Patients understand best when increasing the neobladder capacity is compared with inflating a balloon. It is difficult at the beginning, when the balloon is still collapsed, but becomes easier as the balloon fills.

COMPLICATIONS

After RC and orthotopic reconstruction, early complications can occur as a consequence of retroperitoneal lymph node dissection (RPLND), RC, resection of the intestinal segment, and reservoir construction. Only a large series from a high-volume centre with high-volume surgeons can present representative data on the true early complication rate. The interested reader is referred to two publications that address this issue in >1000 neobladders [3,5].

CONCLUSIONS

RC and ileal neobladder formation represent major surgery with potential relevant early complications even in the most experienced hands. However, the rate of severe and lethal complications is acceptably low.

FROM SURGEON TO SURGEON [6–8]

THE DIFFICULT CASE

Bringing the neobladder safely down to the urethra; in <10% of patients, ileo-urethral anastomosis can cause some difficulties. In two of our 1000 neobladders this manoeuvre failed. Some or all of the following tricks are helpful in overcoming this dilemma: loosening the retractor, straightening the operating table, removing the sacral cushion, neutralizing the extended position of the patient, bringing up the perineum with a sponge stick, freeing the coecum and descending colon, as in RPLND, moving up the neobladder outlet to the tip of the U-shaped flap, or performing an end-to-end anastomosis after tubularization of the U-shaped flap (see Fig. 8). Any incisions into the mesentery of the neobladder should be avoided. The neobladder mesentery should not be pulled roughly towards the pelvic floor.

THINGS TO MAKE LIFE EASIER

Tricks in female neobladder patients: RC is much easier in a female patient than in a male. Nevertheless, many urological surgeons are reluctant to construct a neobladder in a female patient, mostly because they feel unsure about the technique and are anxious about incontinence or hypercontinence. Two tricks are extraordinarily helpful and avoid dysfunctional voiding. First: a well preserved, not denervated urethra with intact suspensory ligaments is required. Preparation of the urethra requires special attention to surgical detail to avoid damage to the proximal urethra, anterior vaginal wall, and urethral support, which could jeopardize the continence mechanism and micturition. The endopelvic fascia is incised immediately lateral to the posterior urethra at the urethrovesical junction, as much of the urethropelvic ligament and paraurethral vascular and nerve plexus as possible must be saved. This step is greatly facilitated when a povidone-iodine pack is placed into the vagina and the urethra rides on top of the anterior vaginal wall. Without this trick, the urethra falls back into the pelvic cavity, and mobilization results in bleeding and jeopardises the urethral support.

Second: Many surgeons suspect the female continence mechanism is close to the bladder neck and locate the resection margin of the bladder too proximally, i.e. into the bladder neck. The correct resection margin is easily determined if the balloon of the catheter is inflated with 50 mL, pulled into the bladder outlet, and the proximal urethra including the catheter is ligated and transected.

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Abbreviations: **RC**, radical cystectomy; **RPLND**, retroperitoneal lymph node dissection; **SAS**, synthetic absorbable suture.