

Surgery Illustrated

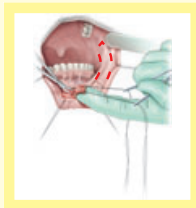
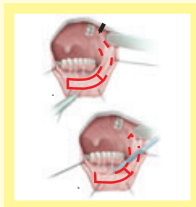
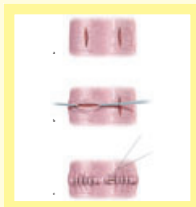
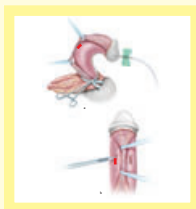
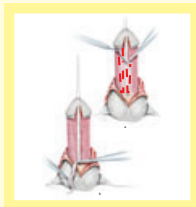
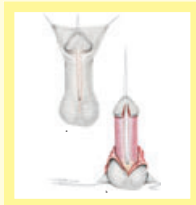
Surgical Atlas

Primary hypospadias repair with buccal mucosa

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Illustrations by STEPHAN SPITZER, www.spitzer-illustration.com



INTRODUCTION

The term 'hypospadias' is derived from the Greek 'hypo', meaning under, and 'spandon', meaning rent or fissure. It is one of the most common anomalies of the external genitalia in males, with a prevalence of up to 3 per 1000 male births. More than 300 operations for its correction, and modifications of these, have been described in innumerable articles. This implies that there is no single ideal solution for all cases and some problems remain unresolved. When E. Durham Smith stated in 1997: 'There is nothing new in surgery not previously described' [1], this is especially true for hypospadias repair. Most 'new' techniques, principles and ideas have already been described before.

Buccal mucosa for creating a neourethra was suggested by Humby in 1941 [2] and by Mirabet in 1964 [3]. Besides the tubularized incised plate technique [4] and the use of vascularized skin flaps, grafts of buccal mucosa have gained popularity for substitution urethroplasty in hypospadias repair since the 1990s [5–7]. Long-term results of buccal mucosa grafts for hypospadias repair are good, with acceptable complication rates [8–16]. However, as in all surgical techniques, patient selection, appropriate indications and careful attention to surgical details are essential for improving the results and reducing complication rates. The absence of hair follicles, sudoriferous and

sebaceous glands, as well as an easy handling of the excised tissue for grafting, are some of the advantages of buccal mucosa.

Preoperative topical application of testosterone as recommended by Monfort and Lucas [17] increases the size of the penis and especially the vascularity of the penile skin, and improves the surgical handling of the tissue and wound healing.

Galen acknowledged in the second century BCE the significance of chordee for the complex of hypospadias malformation [1]. This was almost forgotten until 1842, when Mettauer [18] recognized skin shortening as one cause of chordee. In 1844, Pancoast [19] resected a small section of the tunica albuginea from the dorsal corpora to correct the 'bending problem'. More than 100 years later, Nesbit [20] reported his technique of incising or excising diamond-shaped portions of the tunica albuginea from the dorsum of the corpora cavernosa, and Yachia [21] described an even simpler technique, based on the Heineke-Mikulicz principle in patients with moderate deviation.

PATIENT SELECTION

Children with penile or more proximal hypospadias and a narrow urethral plate, who require substitution urethroplasty, are suitable candidates. When there is

ventral penile curvature during an artificial erection, which is the case in most proximal hypospadias, the primary strategy should be to straighten the penis without transecting the urethral plate in a one-stage substitution urethroplasty (Figs 1–11). If this is impossible and the urethral plate must be transected, a two-stage procedure is the authors' choice (Figs 12–15).

TIMING OF SURGERY

It is currently widely accepted that surgery should be completed before the child enters pre-school or kindergarten, although there is no evidence base for an ideal age for hypospadias surgery. Some surgeons prefer to operate on the child at 6 months of age, while others like to wait until the child is 2 years old. In an otherwise healthy child, we operate between the first and second year of life, depending on the size of the external genitalia, and his parents' preference. In patients with a small glans and/or a poorly

vascularized skin, topical testosterone cream is applied (testosterone propionate 0.5% cream or dihydrotestosterone 2% cream for 4–6 weeks); this is of advantage in most proximal hypospadias.

SPECIFIC INSTRUMENTS AND MATERIALS

- Optical loupes (×2.5–5.5);
- Marking pen;
- Microsurgical instruments, e.g. forceps, needle driver, scissors;
- 8 F polyurethane fenestrated stent;
- 5–0 polypropylene monofilament sutures (Prolene®, Ethicon, USA);
- 5–0 poly-p-dioxanone monofilament sutures (Mono-Plus®, Braun, Melsungen, Germany);
- CV-6 PTFE sutures (Gore-tex®, WL Gore Assoc., Newark, DE, USA);
- 6–0 glyconate monofilament sutures (Monosyn®, Braun);
- 6–0 polyglytone monofilament sutures

(Caprosyn®, Tyco Healthcare, Mansfield, MA, USA);

- 7–0 polyglycolic acid braided sutures (Safil®, Braun);
- Ophthalmic scalpel (Micro Feather; Feather Safety Razor, Osaka, Japan)
- Xylocitine 1 : 100 with adrenaline 1 : 200 000 (for buccal submucosal injection);
- Tourniquet;
- Vessel loops;
- Seemann-Seifert mouth retractor;
- Langenbeck retractor;
- Non-adhesive wound dressing (Melolin®, Smith and Nephew, USA);
- Cohesive elastic fixation bandage (Gazofix® colour, BNS Medical, Ankara, Turkey);
- Dexpanthenol cream (Bepanthen® cream, Bayer vital, Leverkusen, Germany).

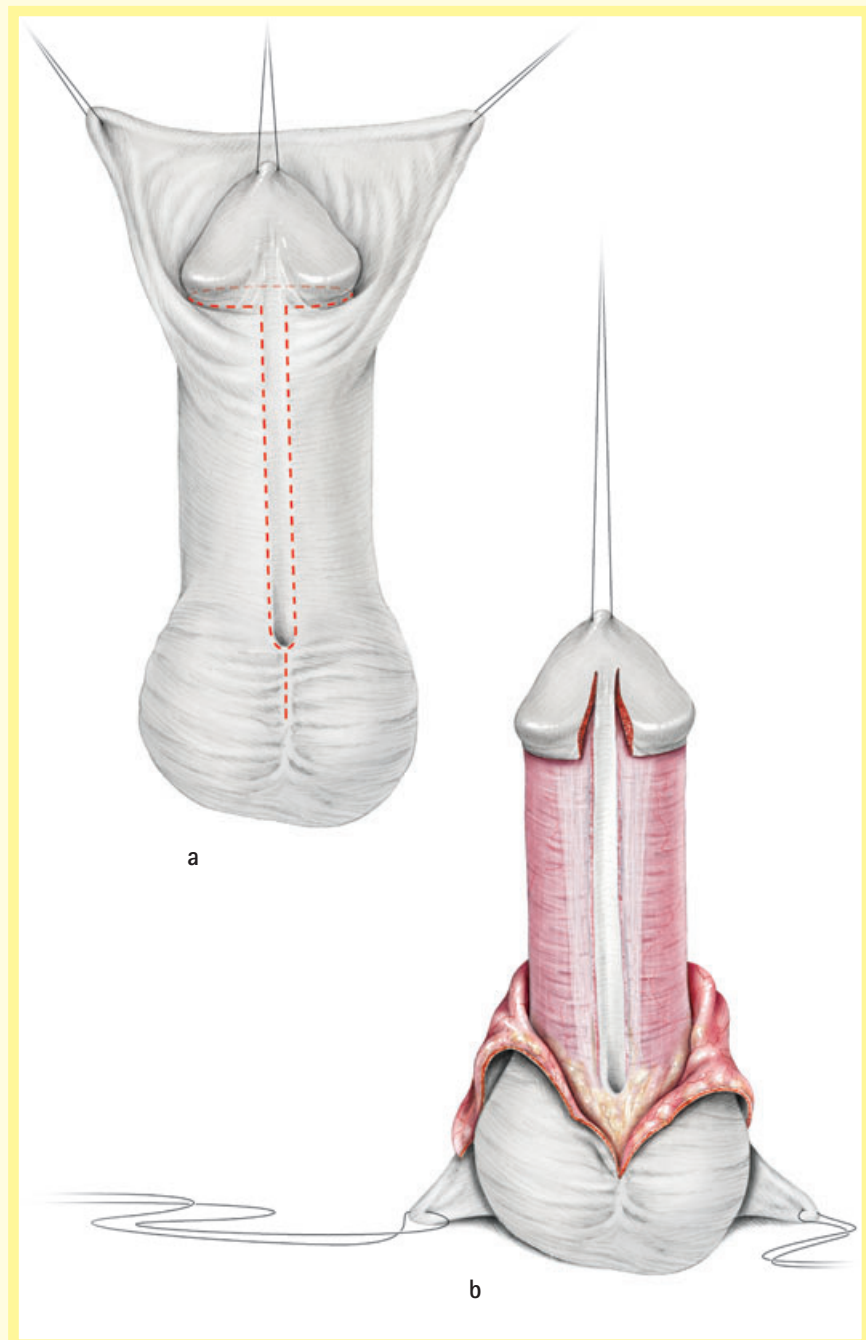
The patient is placed supine; in addition to general anaesthesia a caudal block is advisable by injecting a local anaesthetic (e.g. carbostesin 0.25%, maximum 2 mg/kg) into the caudal canal. Nasal intubation facilitates dissection and excision of the buccal mucosa.

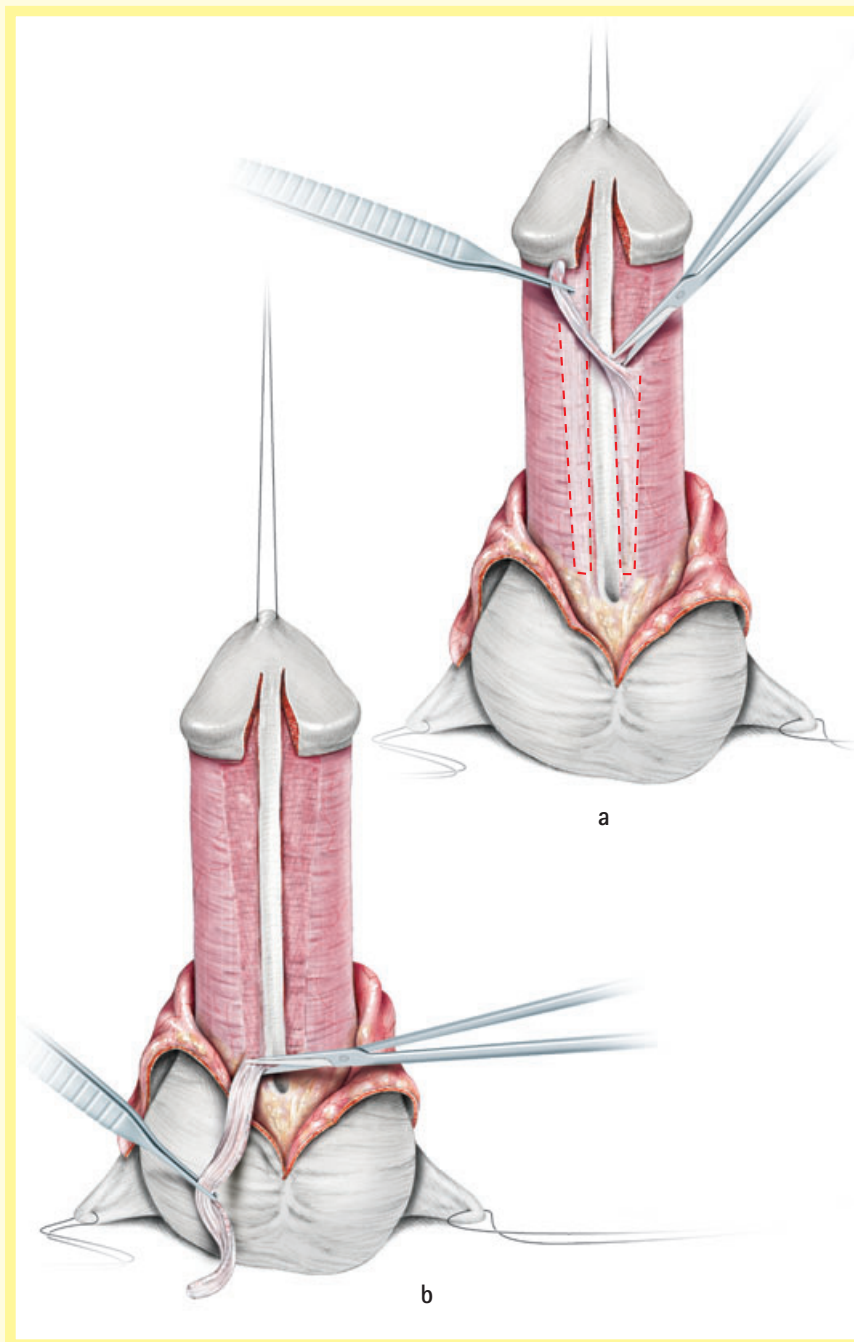
SINGLE-STAGE SUBSTITUTION URETHROPLASTY WITH BUCCAL MUCOSA

Figure 1

(a) A 5-0 polypropylene traction suture is placed through the glans; this suture will also be used for securing the urethral stent at the end of surgery. Two stay sutures are placed into the dorsal edges of the prepuce. After marking the incision line along the urethral plate and around the sulcus coronarius, the skin is incised. Care should be taken to leave a sufficient rim of inner prepuce on the ventral side, so that the 'mucosal collar' of the glans can later be approximated in the midline.

(b) The penis is degloved down into the scrotum until normal corpus spongiosum appears. The longitudinal incisions along the urethral plate are extended into the glans and down to the corpora cavernosa. The authors prefer to complete the dissection with straight scissors down to the corpora cavernosa.



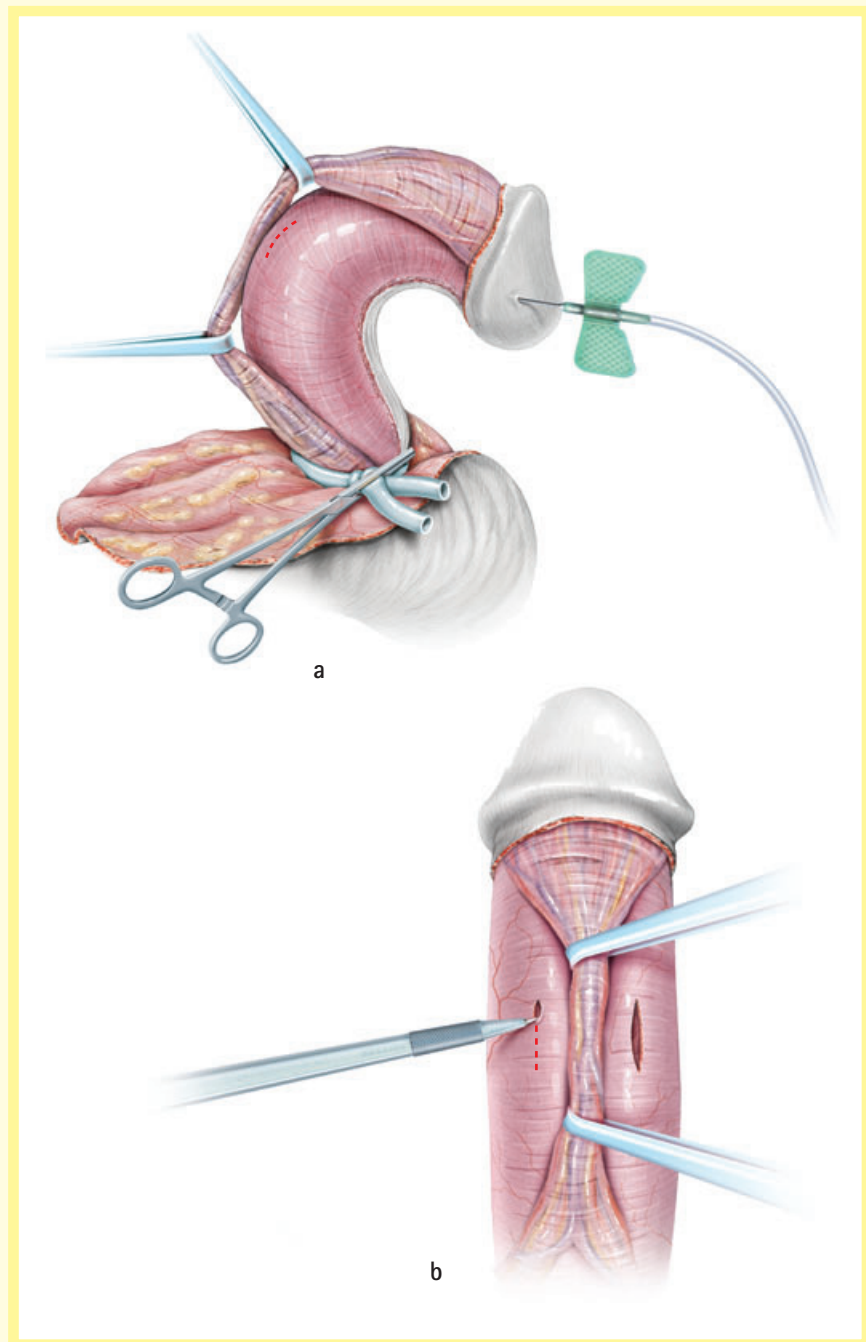
**Figure 2**

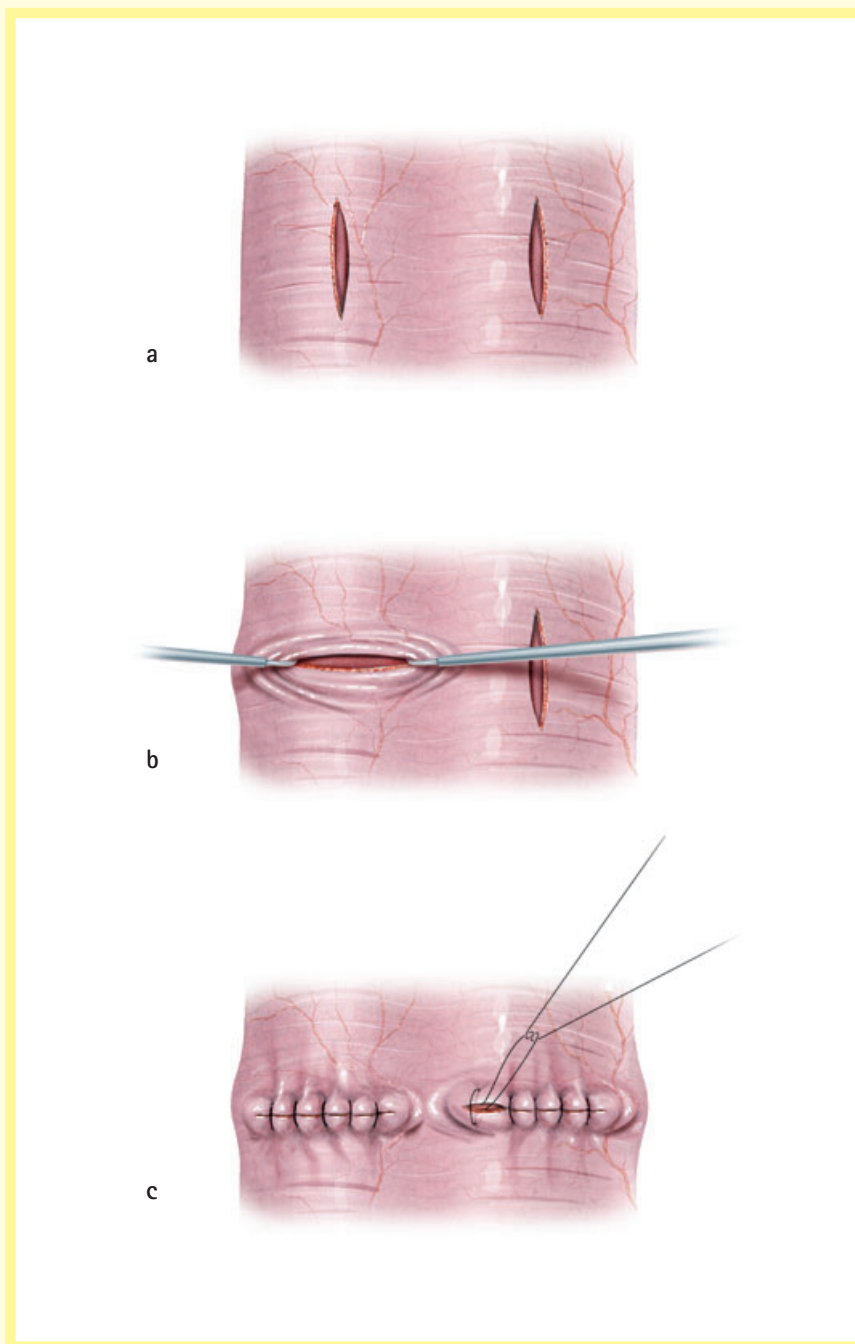
(a,b) The chordee is dissected and excised along both sides of the urethral plate until normal corpus spongiosum appears. Either microscissors or Metzenbaum scissors may be used for excising the chordee. Care has to be taken not to injure the urethral plate or the corpus cavernosum. The urethral plate should also not be touched with the forceps, to avoid scars in the plate. It is crucial to preserve a nonfibrotic and well-vascularized urethral plate.

Figure 3

(a) After degloving the penis and dissection of the chordee, an artificial erection is induced. On both sides, an 18 G needle is placed through the glans into the corpora cavernosa or proximal to the glans directly into the corpora cavernosa lateral to the neurovascular bundle. In patients with persisting curvature after excision of chordee, the neurovascular bundle is carefully dissected from the corpora cavernosa and lifted by vessel loops. This dissection starts on both sides ventrally where the chordee has been excised and is completed around the dorsum of the penis.

(b) For correcting a modest penile deviation the Yachia straightening procedure is used. Using an ophthalmic scalpel, small (≈ 5 mm) longitudinal incisions are made into the tunica albuginea of the corpora cavernosa on either side down to the spongy tissue.



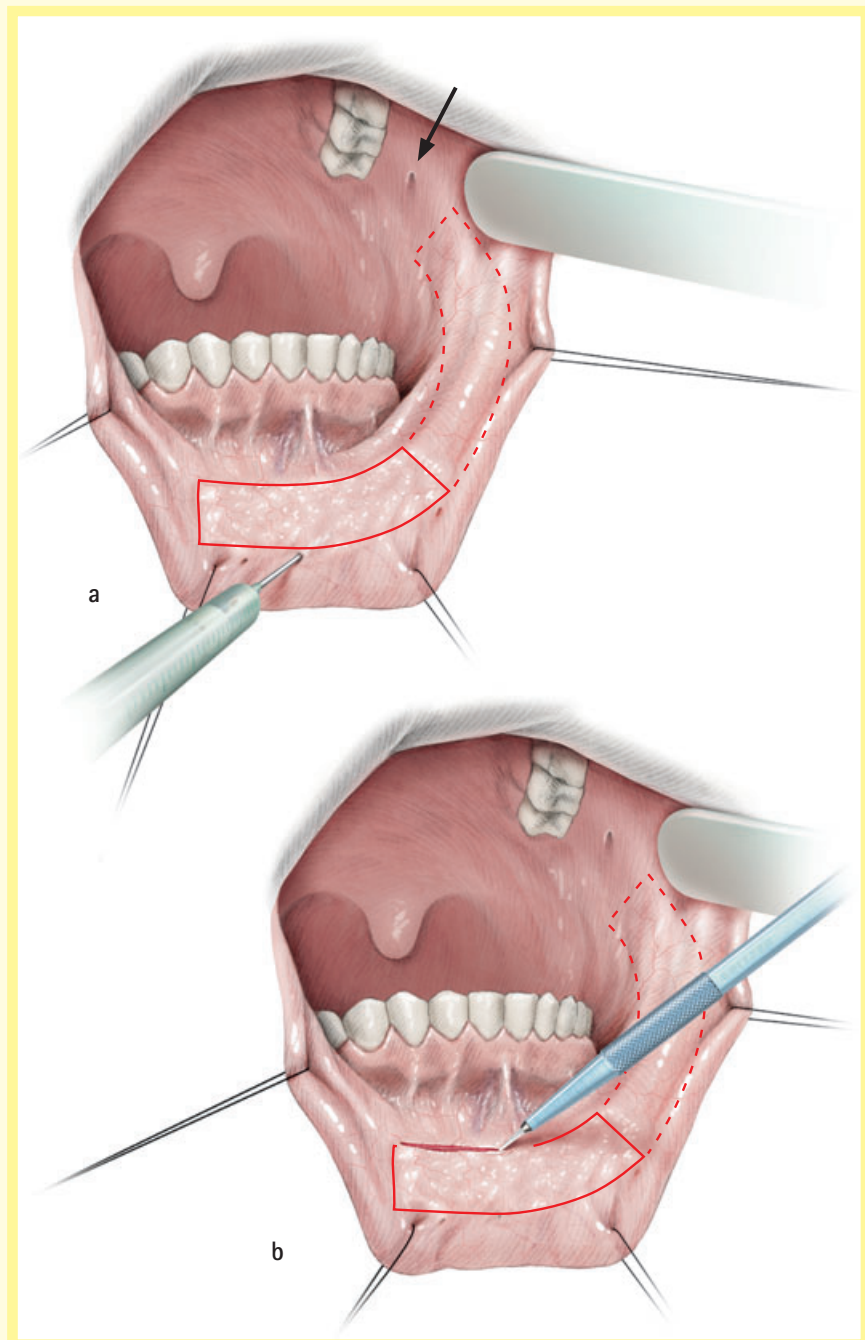
**Figure 4**

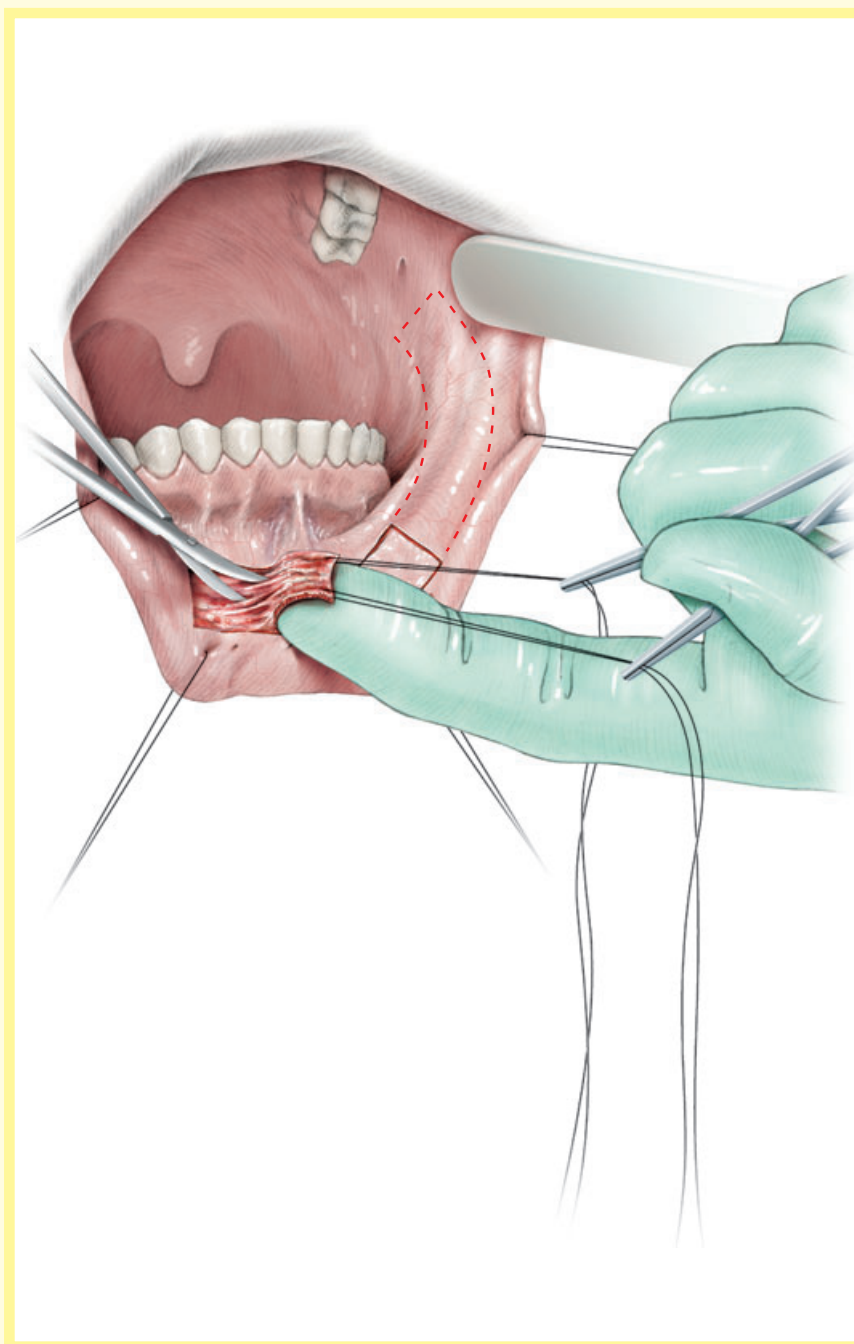
(a) Longitudinal incisions of the tunica albuginea (5–7 mm, depending on the size of the penis) are made. (b) The longitudinal incision is stretched transversally using hook-retractors. (c) The margins are adapted with 5–0 polypropylene or 5–0 poly p-dioxanone sutures using inside-out and outside-in sutures so that the knots are buried.

Figure 5

(a) For harvesting the buccal mucosa, the mouth is disinfected with a mucosa-specific solution (octenidine dihydrochloride, Octenisept®, Smith & Nephew). Four traction sutures are placed at the border between red lip skin and buccal mucosa. A spatula or small Langenbeck retractor is used to expose the cheek mucosa, if needed. Shrinkage of the graft of $\approx 20\%$ must be considered when marking the incision lines. Either buccal mucosa from the lower lip (solid lines) or from the inner cheek (dotted lines) may be used. When harvesting buccal mucosa from the inner cheek, care must be taken not to injure the orifice of the parotid duct (arrow). Submucosal injection of 2–4 mL xylocaine 1% with adrenaline 0.0005% facilitates separation of the mucosa from the fat of the buccal submucosa and reduces postoperative pain.

(b) For harvesting buccal mucosa from the lower lip (solid lines), the mucosa is incised on three sides, using an ophthalmic scalpel, leaving one lateral end pedicled (as shown on the left side). This has the advantage that the excision may be extended into the cheek, if necessary.



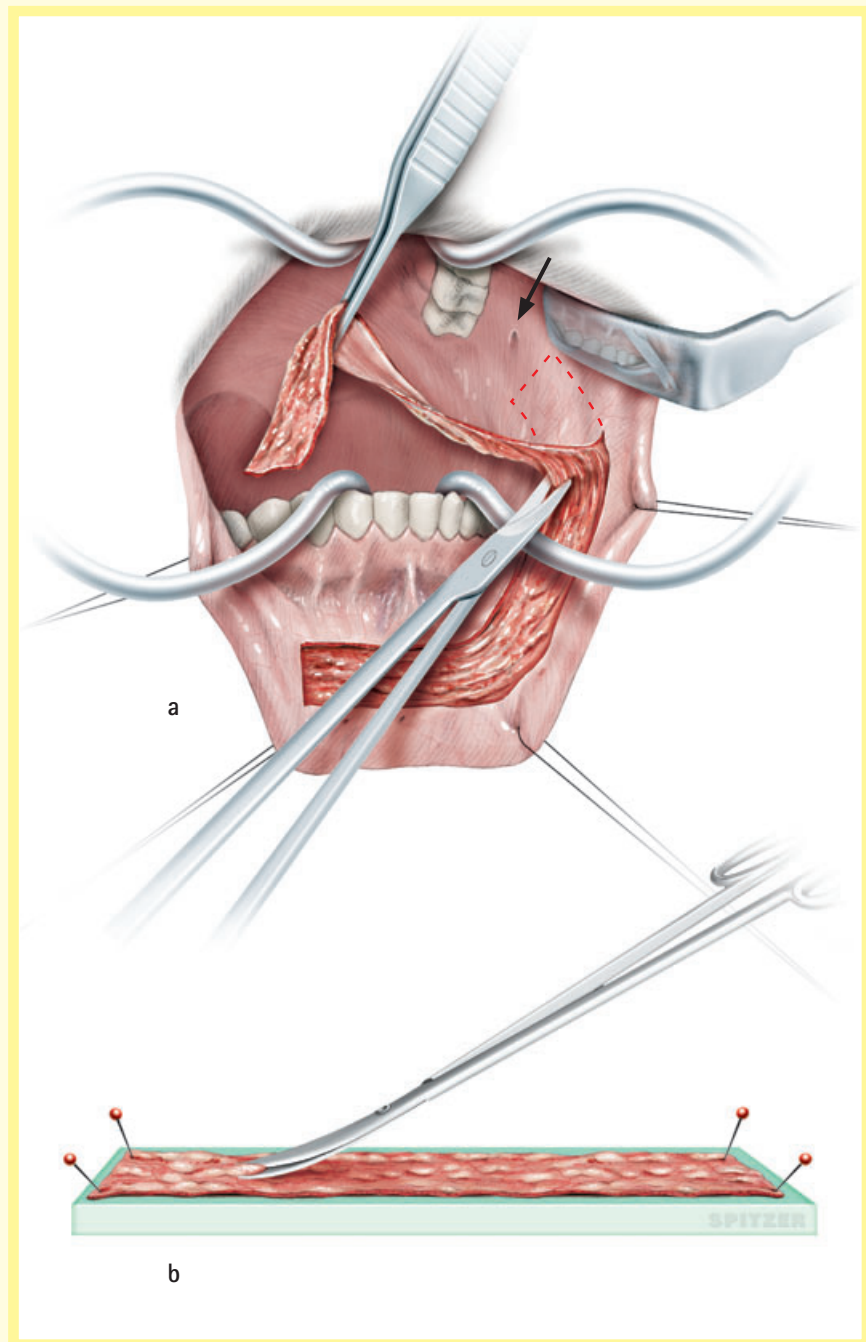
**Figure 6**

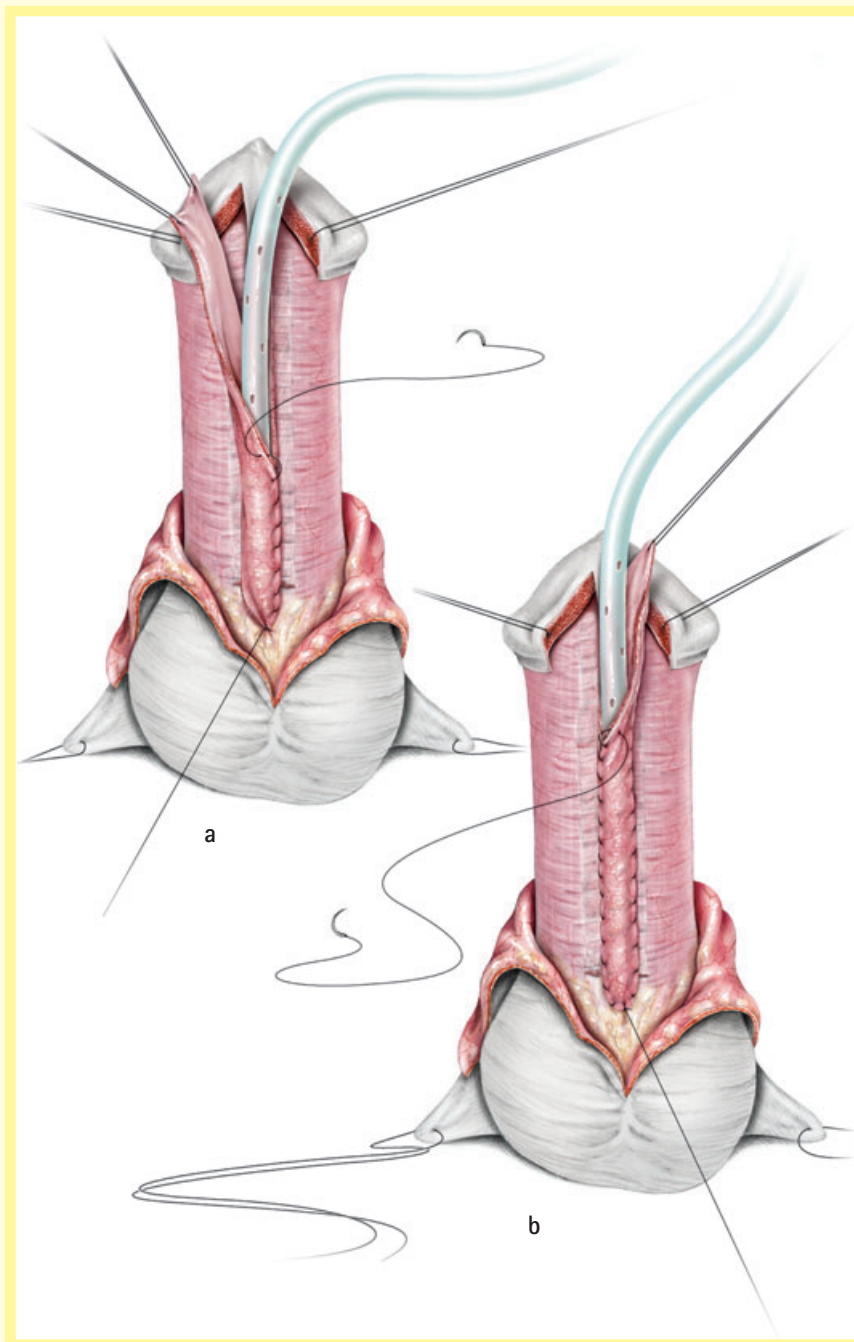
Two stay sutures are placed at the lateral corners of the buccal mucosa strip. To avoid injuring the graft, the dissection is done using small blunt Metzenbaum scissors. It is crucial to dissect precisely in the plane between mucosa and buccal submucosal fat, harvesting a thin graft of even thickness. If only a lower lip buccal mucosa strip is required and has been successfully dissected, it is completely excised by transection of its lateral pedicle (solid line).

Figure 7

(a) If a longer strip is needed and the dissection has to be extended into the cheek, a Seemann-Seifert mouth retractor and a Langenbeck retractor are used. Care must be taken not to injure the orifice of the parotid duct (arrow), which is located beneath the second upper molar. The mucosal defect on the inner cheek should be closed by a running 6-0 polyglytone suture. However, with the lower lip as a harvesting site, the mucosal defect may remain open and be subjected to secondary wound healing without any problems.

(b) The graft is freed from the adherent fatty tissue, using curved, blunt scissors. For this purpose, the strip can be fixed to, e.g. a sterilized cork plate by means of small needles.



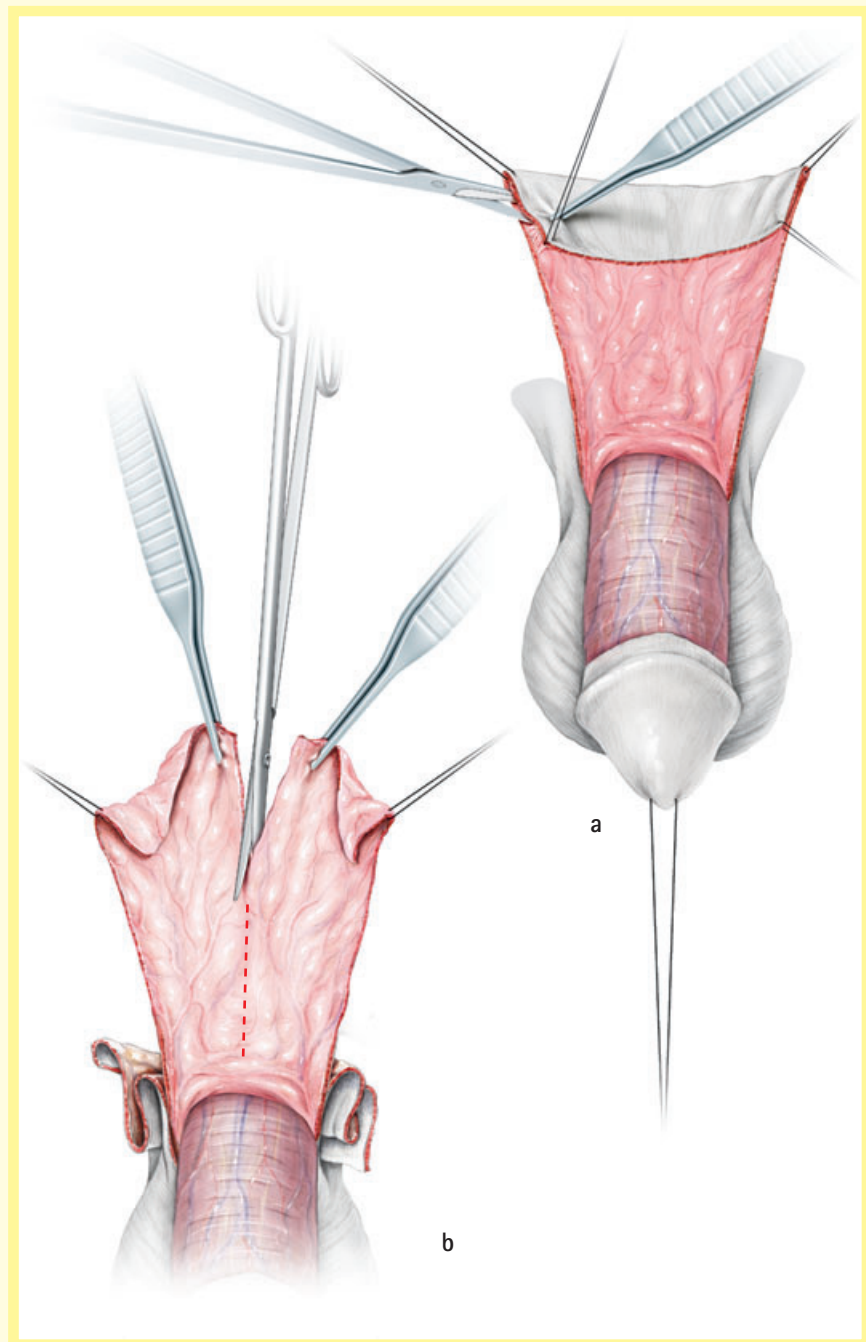
**Figure 8**

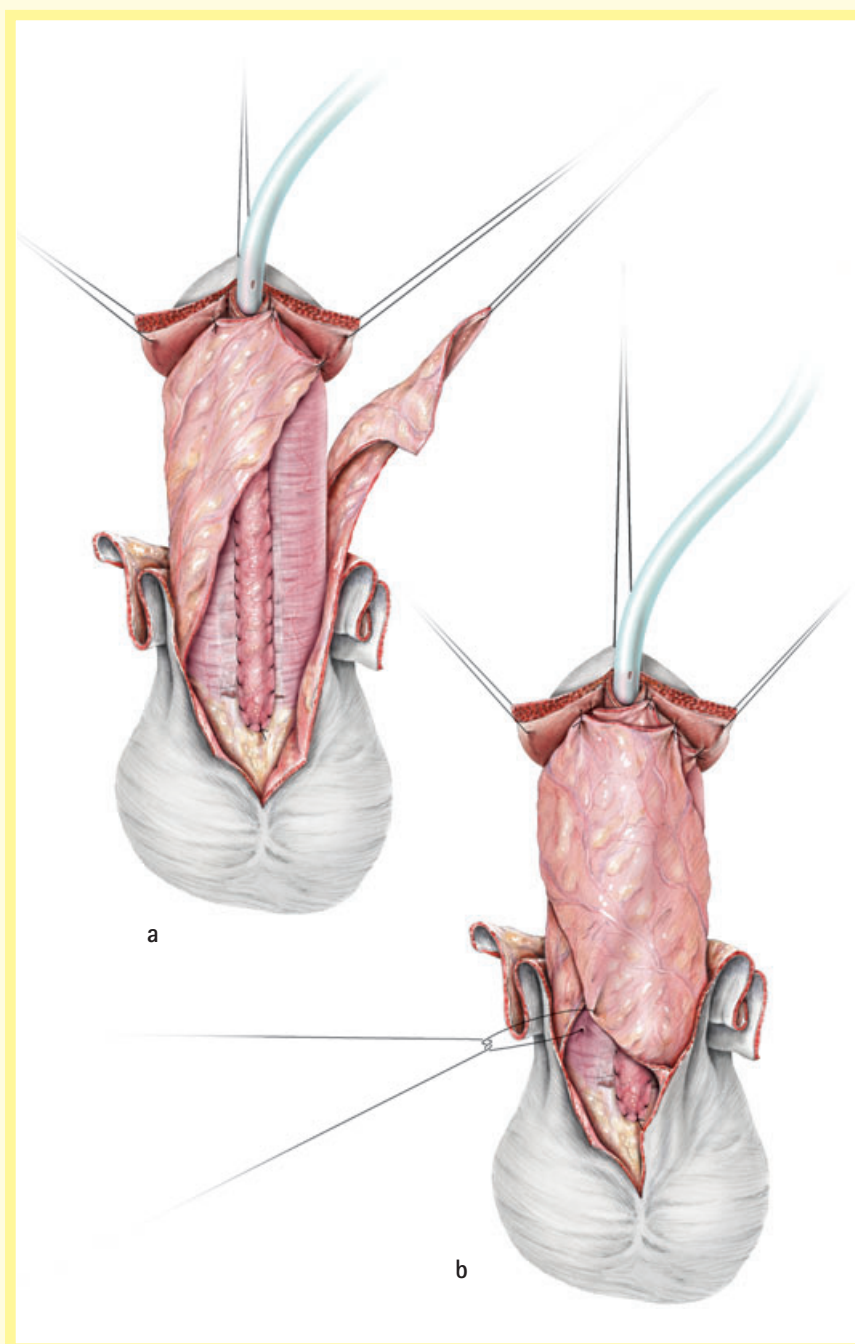
(a,b) An 8 F polyurethane fenestrated stent is inserted into the urethra but not advanced into the bladder. The buccal mucosa is sutured as an onlay graft to the urethral plate with the mucosa facing towards the lumen using running sutures. In case of a very thin mucosal strip, as in very small children, 7-0 polyglycolic acid sutures are used. In older children or adults, 6-0 polyglytone monofilament sutures are used, which have the advantage of a shorter resorption time. Intracuticular sutures are placed through the submucosal layer of the buccal mucosa and the urethral plate, so as to invert the mucosa, lowering the risk of fistula-development.

Figure 9

(a) The inner layer of the foreskin is dissected and unfolded, and dartos fascia is dissected from the preputial hood and part of the dorsal shaft skin, to be used to cover the buccal mucosa graft with well vascularized tissue.

(b) The flap of dartos fascia is cut in the midline, carefully preserving the blood vessels. Holding sutures facilitate this step.



**Figure 10**

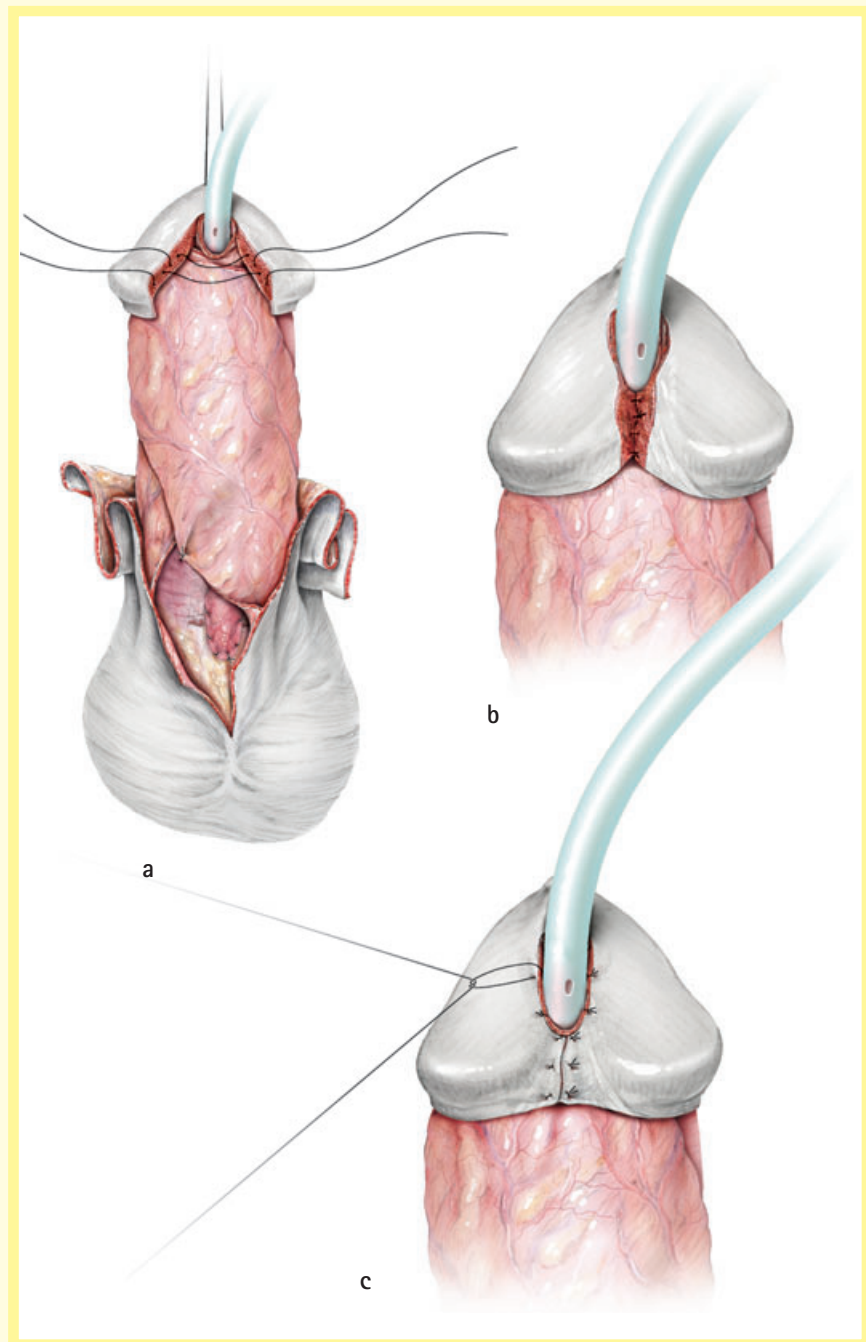
(a) The right dartos flap is rotated to the ventral side of the penis. The ends are sutured underneath the previously mobilized glans wings.

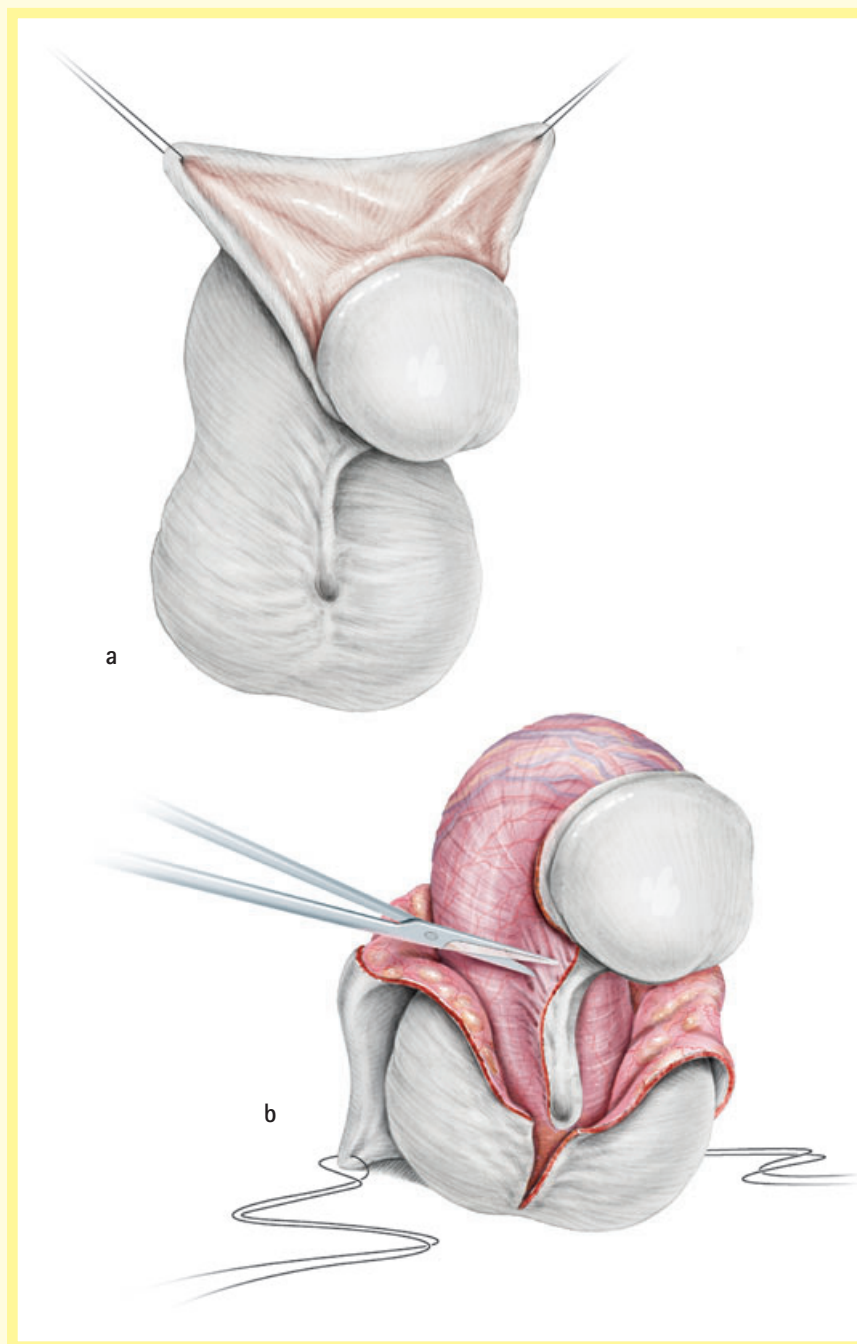
(b) The left dartos flap is brought in the same manner to the ventral side of the penis. By crossing them above the ventral midline, both dartos flaps cover the buccal mucosa onlay graft. If the proximal part of the buccal mucosa onlay graft is not fully covered, subcutaneous tissue is also mobilized from the tunica dartos of the scrotum. The flaps are secured by 6-0 glyconate sutures.

Figure 11

(a,b) The reconfiguration of the glans is a crucial surgical step for the cosmetic appearance. The glans is closed in two layers. Two to three horizontal mattress sutures (5-0 or 6-0 poly p-dioxanone) are placed into the spongy tissue of the glans.

(c) The epithelium of the glans is adapted by two to three horizontal sutures (7-0 polyglycolic acid). The meatus of the neourethra is adapted to the epithelium of the glans by 7-0 polyglycolic acid sutures to create a slit-like neomeatus. Avoiding a narrow closure of the meatus lowers the risk of developing a meatal stenosis.



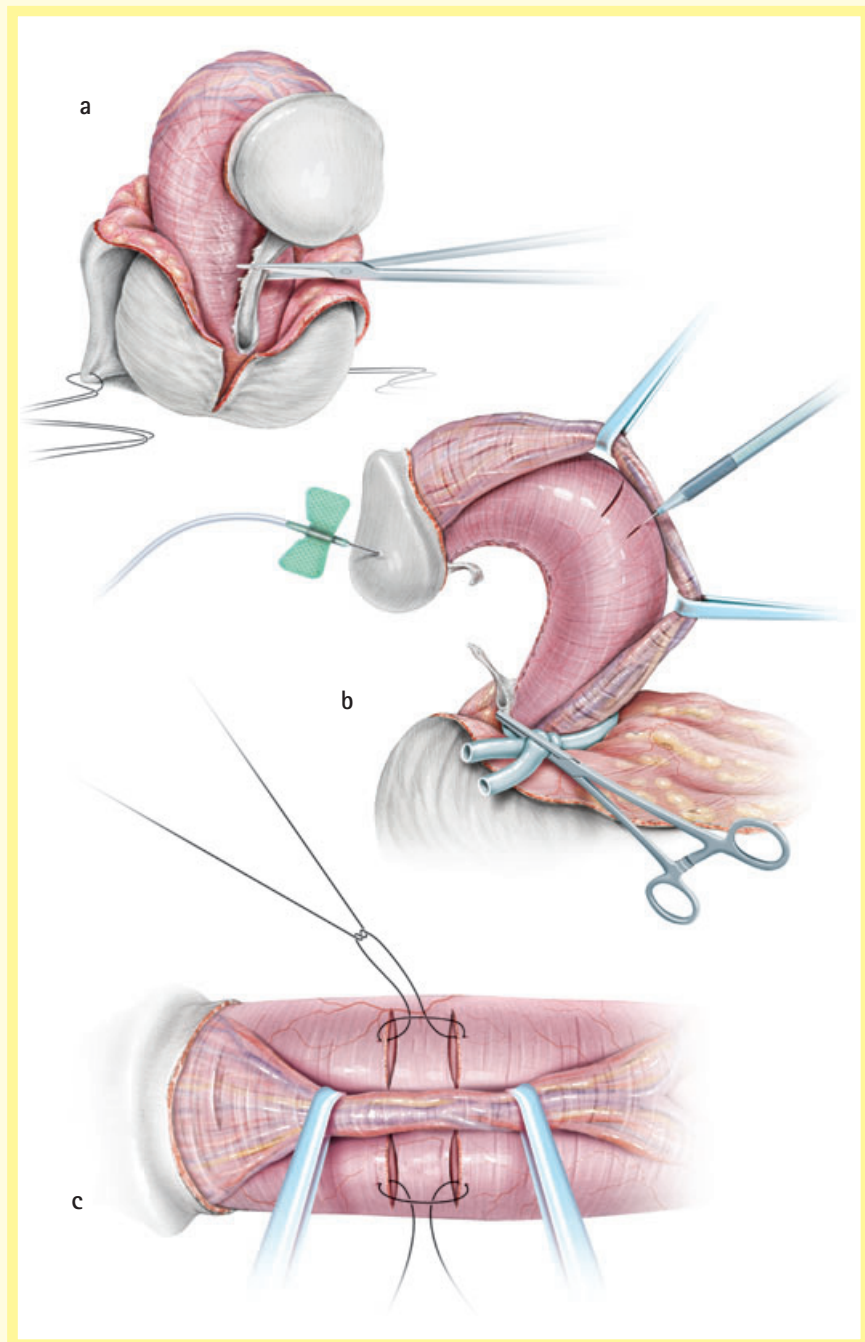
**Figure 12**

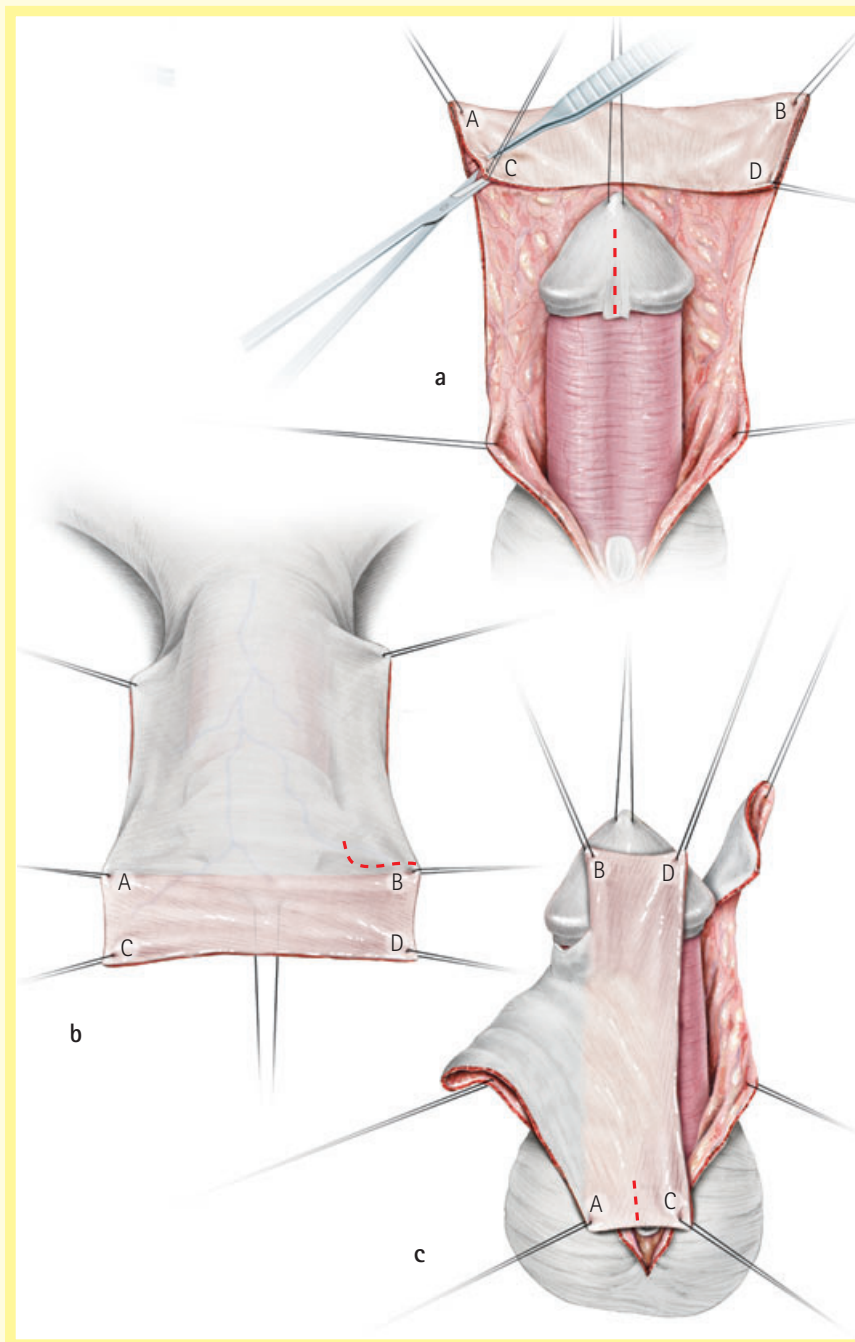
(a) In patients with a short urethra, the skin incision is made along the urethral plate and around the sulcus coronarius the same way as in Figure 1. (b) All fibrotic tissue of the chordee along the urethra is removed.

Figure 13

(a) If the urethra remains too short after dissecting all chordee tissue, the urethral plate is transected and a staged procedure is used. (b) If, on the artificial erection, there is still significant curvature after transecting the urethral plate and removing all chordee behind the urethral plate, a penile straightening procedure is required. After mobilizing the neurovascular bundle, two dorsal horizontal incisions are made into the tunica albuginea at the dorsum of both corpora cavernosa down to the spongy tissue at the point of the maximal curvature.

(c) The bridge of the tunica albuginea between the incisions is submerged by adapting the lateral margins of tunica incisions with CV-6 PTFE sutures using inside-out and outside-in sutures so that the knots are buried. If necessary, additional incisions are placed, according to the remaining curvature.



**Figure 14**

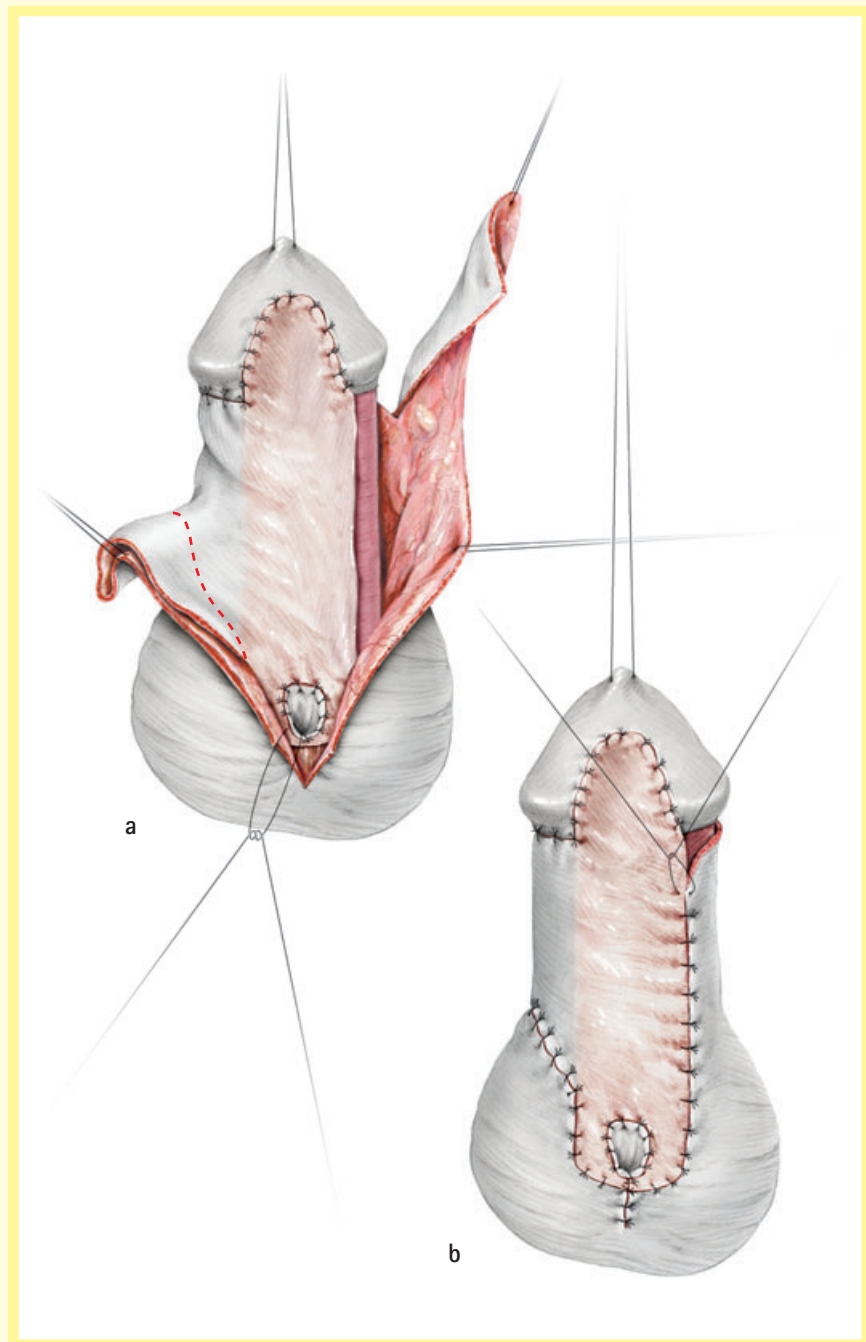
(a) For covering the ventral shaft of the penis the dorsal foreskin is dissected and unfolded, preserving carefully the vascular supply to the inner layer of the foreskin. The inner preputial layer will later become the dorsal substitute plate of the neourethra. If the urethral plate in the glans appears to be narrow, it is incised up to the tip of the glans and down to the corpora cavernosa for substitution by the inner layer of foreskin.

(b) The inner layer of the foreskin is separated over 5–10 mm from the proximal skin (dotted line) to allow the extension of the substitute into the glans, if necessary. The width of the foreskin (distances A-B and C-D) may be trimmed according to required length of the substitute urethral plate.

(c) The skin is wrapped around the penis, and the inner layer of the prepuce is spatulated in the middle between A and C over a length of ≈ 5 mm, to wrap around the neomeatus of the urethra.

Figure 15

(a) The substitute urethral plate of the inner layer of the foreskin is adapted by single sutures of 7-0 polyglycolic acid to the neomeatus and the glans; surplus penile skin is trimmed. (b) The neomeatus in the scrotal area has been embedded in the foreskin. The penile shaft skin is adapted by 6-0 glyconate sutures.



POSTOPERATIVE CARE

After fixing the urethral stent with the 5–0 polypropylene traction suture, the penis is wrapped with a nonadhesive dressing (Melolin®), covered with dexpanthenol cream. Moderate compression is achieved by wrapping the dressing with a cohesive elastic fixation bandage (Gazofix® colour). The dressing is fixed at suprapubic skin with three or four sutures. It is important to immobilise the penis after surgery to secure revascularization of the free buccal mucosa graft. In patients having a single-stage procedure, a suprapubic catheter is placed for urinary diversion. The compressive dressing is removed after 10 days. The urethral stent is removed after 20 days and the cystostomy catheter is removed after initiating voiding with no significant residual urine volume. Antibiotic prophylaxis is given as long as the stent is in place, generally a third-generation cephalosporine. For pain control, the children receive ibuprofen or paracetamol. To avoid painful erections during the night, some children require diazepam 2.5 mg suppositories before sleep.

In children having a staged procedure, a transurethral silicone Foley catheter is placed for 10 days after the first stage. The second stage is done 6–9 months later, when the inner layer of the preputial skin may be wide enough to be closed into a neourethra without using an onlay for urethral substitution. When a buccal mucosa onlay is required to complete the neourethra, this is mostly the case at the proximal or distal ends of the substitute urethral plate. Under all circumstances, the use of a buccal mucosa graft is preferred over the use of hair-bearing penile shaft or scrotal skin.

SURGEON TO SURGEON

Morbidity after surgery at the graft donor site is minimized by leaving the buccal submucosal fat on the muscle when harvesting only the mucosa. Bipolar coagulation of small vessels is used only if bleeding does not stop spontaneously. Using this technique, we have so far had only a few problems of scarring at the donor site. The wound is left open for secondary healing and covered by a wet sponge only. When buccal mucosa is used from the cheek, this wound is closed with a running polyglytone suture. Children can start eating on the evening of

surgery. In children, buccal mucosa from the lower lip is thinner than that from the cheek and the morbidity is minimal. However in adults, the morbidity of the donor site may be lower if the buccal mucosa is taken from the cheek and the defect is closed.

One of the most common problems of hypospadias repair is fistula formation. Careful coverage of the graft by dartos fascia is essential. Moderate, i.e. not too tight, compression of the penis to avoid haematoma formation, immobilization of the penis to allow revascularization, and use of rapidly absorbable suture material to reduce the risk of fistula formation, are the key issues for uneventful healing in hypospadias repair.

It is important to prevent meatal stenosis. This is achieved by not closing the glans up to the tip, which creates a round meatal orifice like the crater of a volcano. Instead, the meatal orifice of the neourethra should be oval and adapted to the epithelium of the glans from the tip down to half of the ventral aspect of the glans. Leaving the neomeatus in the coronal position without adaptation of the glans over the neourethra in an infant results in a cosmetically less appealing appearance when entering adolescence. During puberty, these adolescents tend to seek further surgical correction despite a perfect functional result.

Stenosis at the proximal anastomosis is rare, but may occur during the follow-up. In these cases, endoscopic incision of a mostly small fibrotic ring resolves the problem in most cases.

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