# General Considerations in Hypospadias Surgery

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## Abbreviations

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|---|---|
| TIP | Tubularized Incised Urethral Plate Urethroplasty |
| TUPU | Tubularized Urethral Plate Urethroplasty |

## 5.1 Introduction

Incidence of hypospadias is 1:300, and it is the second most common congenital anomaly. Diagnosis of the anomaly is made in the newborn by locating the ventral urethral opening/altered urinary stream and dorsal hood. The terminology "hypospadiologist" was coined by John Duckett's enduring legacies in hypospadias surgery. Hypospadiology is a well-recognized and evolving speciality. The surgeon dedicated to excellence, develops and maintains the high standards of specialist expertise, with sufficient case load in hypospadias surgery is called Hypospadiologist. John Duckett stated, "many successful methods for hypospadias surgery, no single technique works for all cases, so a suitable technique required to be chosen for the individual case". The outcomes of hypospadias surgery have improved significantly in the last three decades by sincerely following the quotes of Davis "I believe the time has arrived to state that the surgical repair of hypospadias is no longer dubious, unreliable, or extremely difficult. If tried and proven methods are carefully followed, a good result should be obtained in every case. Anything less than this suggests that the surgeon is not temperamentally fit for this kind of surgery" [1]. Now the "occasional" hypospadias surgeon is disappearing fast; the commitment and skill of the surgeon matter most in "Hypospadiology". The hypospadias surgery is technically demanding; so, anyone of the Urologist, Paediatric Surgeon, Paediatric Urologist, Plastic Surgeon, and general surgeon having the temperament for hypospadias surgery can perform the repair. The surgeon has to master at least six standard techniques in hypospadias with at least 40 to 50 cases load per year. The learning curve in hypospadias repair is lon-

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ger and experience in hypospadias surgery co-relates with better results. The difference in results of hypospadias surgery done by the Hypospadiologists and Paediatric Surgeons versus other surgical specialists is significant [2, 3].

## 5.2 Epidemiological Trends

True worldwide prevalence of hypospadias is not known. Recently reported total international prevalence of hypospadias was 20.9 per 10,000 births. A rising trend in the prevalence in the past three decades has been reported, but it is localized to specific regions or periods. The prevalence of hypospadias is variable region-wise; Asia 0.6–69, Europe 18.6, North America 34.2 (6–129.8) per 10,000 births.

## 5.3 Should Hypospadias Be Operated?

Initially, the focus was mainly on proximal hypospadias repair with more on the creation of urethral passage, that too only up to corona. The proximal defect is most challenging to repair and has higher morbidity. With advancements in hypospadiology, the MAGPI technique came into practice and was described in the 1980s; it became the routine in distal hypospadias. But now, tubularized incised urethral plate urethroplasty is the most commonly done technique in distal hypospadias because of its better functional and cosmetic results. Hypospadias surgery is indicated because of ventral ectopic/stenotic meatus, ventral curvature, cleft/tilted glans, deformed hooded prepuce, penile torque, and penoscrotal transposition. The ideal outcome of the surgery includes the straight and adequate sized penis, right calibre urethra with meatus at the tip of the conical glans for normal voiding in a good stream, and unimpaired sexual activity. The development of the hypospadiac boys should be with self-confidence and a standard body image for young men after hypospadias surgery. Severe hypospadias with poor surgical results negatively impacts those with minor hypospadias and satisfactory surgical outcomes. Results, both functional and cosmetic, in modern-day hypospadias surgery have improved significantly; so, all types of hypospadias with or without chordee or torsion should be considered for surgery.

## 5.4 Preoperative Workup

The preoperative workup includes history, a medical checkup, and investigation of the child and counselling of the parents. The goals of the surgery must be discussed with the parents, and they should be told about the surgical plan, possible modifications during surgery, the period of hospitalization, peri and postoperative catheter care, dressings and medications, and expected outcome of the surgery and complication. The perineum should be inspected for any infection or diaper rashes, and surgery should be done only after its treatment. Genitalia should be examined to note the size of the penis, site and size of the meatus, width, length and development of the urethral plate, length of the hypoplastic urethra, chordee/torsion and their severity, shape and size of the dorsal hood, penoscrotal transposition and its severity and other associated anomalies like undescended testis, inguinal hernia. Multiple pinpoint dimples can be seen in the urethral plate along the side of the meatus. The location of the meatus should be confirmed by a probe in these cases [4]. Passing a probe is likely to diagnose the partial duplication of the urethra (Fig. 5.1a, b), which is laid open to convert it to one urethra during the repair. Careful examination and evaluation will diagnose the other associated congenital anomalies like undescended testis, inguinal hernia, hydrocele, the disorder of the sexual differentiation, renal agenesis, pelvic ureteric junction obstruction, and vesicoureteral reflux [5].

Careful inspection and examination of the median raphe depict much information about the embryological events. The degree of deviation of median raphe is directly proportional to the degree of torsion (Fig. 5.2a) and is an excellent method of measuring torque in cases of torsion with phimosis (Fig. 5.2b). Site of bifurcation of

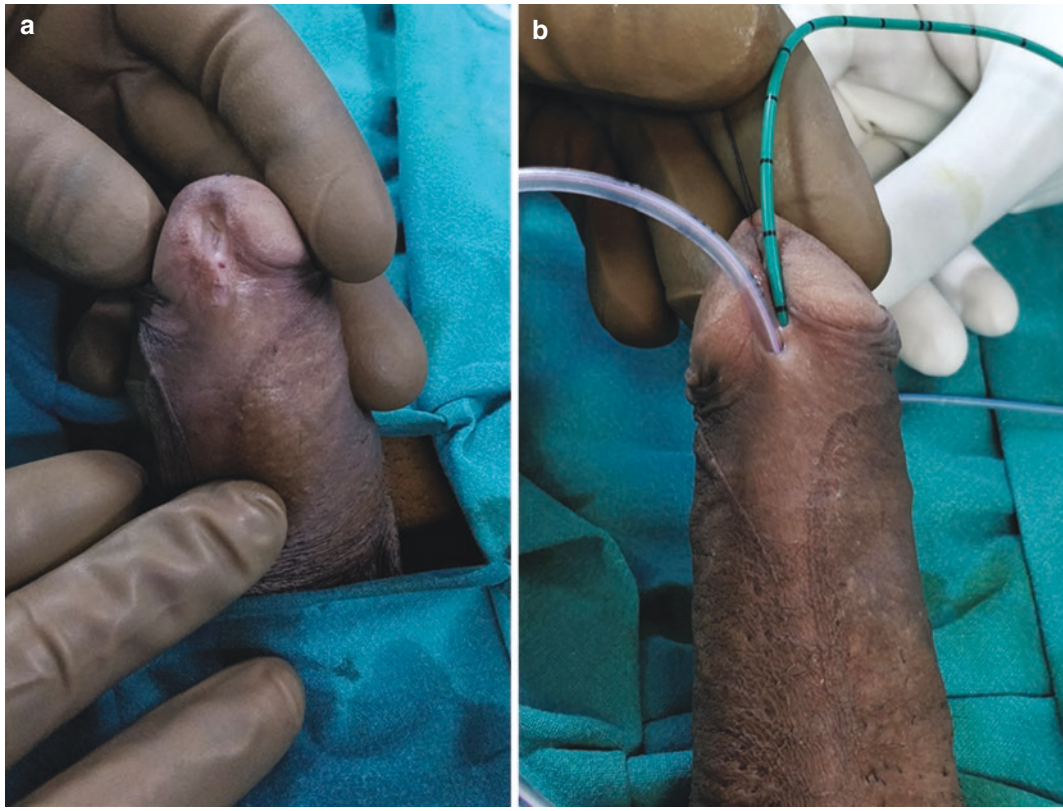


**Fig. 5.1** Partial duplication of urethra (**a**) showing two openings. (**b**) Probing with ureteric catheter shows partial duplication of the urethra

median raphe and place of the dorsal Bull's eye indicate bifurcation of spongiosum and degree of chordee (Fig. 5.3a, b). Patients with severe hypospadias with or without penoscrotal transposition (Fig. 5.4a, b) are evaluated for internal sex organs, karyotyping, and USG for upper tract anomalies [6, 7]. Urethrogram and endoscopy are proper investigations to diagnose prostatic utricle. Large prostatic utricle makes catheterization difficult and can be a source of infection after surgery. Severe hypospadias with unilateral or bilateral undescended testis, a dimple in the perineum, or bifurcation of median raphe should be evaluated for disorders of sexual differentiation (Fig. 5.5a, b). Radiological imaging with ultrasonography and/or MRI for other urinary tract anomalies and internal genital organs and karyotyping should also be done in such patients [6]. Examination under anaesthesia helps better assess the type and severity of the hypospadias, degree of the chordee, and urethral plate quality. Therefore, the surgical plan is likely to be changed on the table [7].

## 5.5 Timing of Surgery

Hypospadias is usually diagnosed during the routine examination of the external genitalia just after the birth or during an inspection at the time of newborn circumcision. There is a delay in diagnosis of hypospadias with intact foreskin (Mega-meatus intact prepuce), and it is seen only with retraction of the foreskin or after circumcision later in life. The first milestone in the treatment is at the birth of the child. Parents must be informed and counselled about the anomaly, when the surgery is done, and the results. This is the proper time to establish a trust bond and confidence between parents and the surgeon to help remove the unknown fear, guilt, worry, better

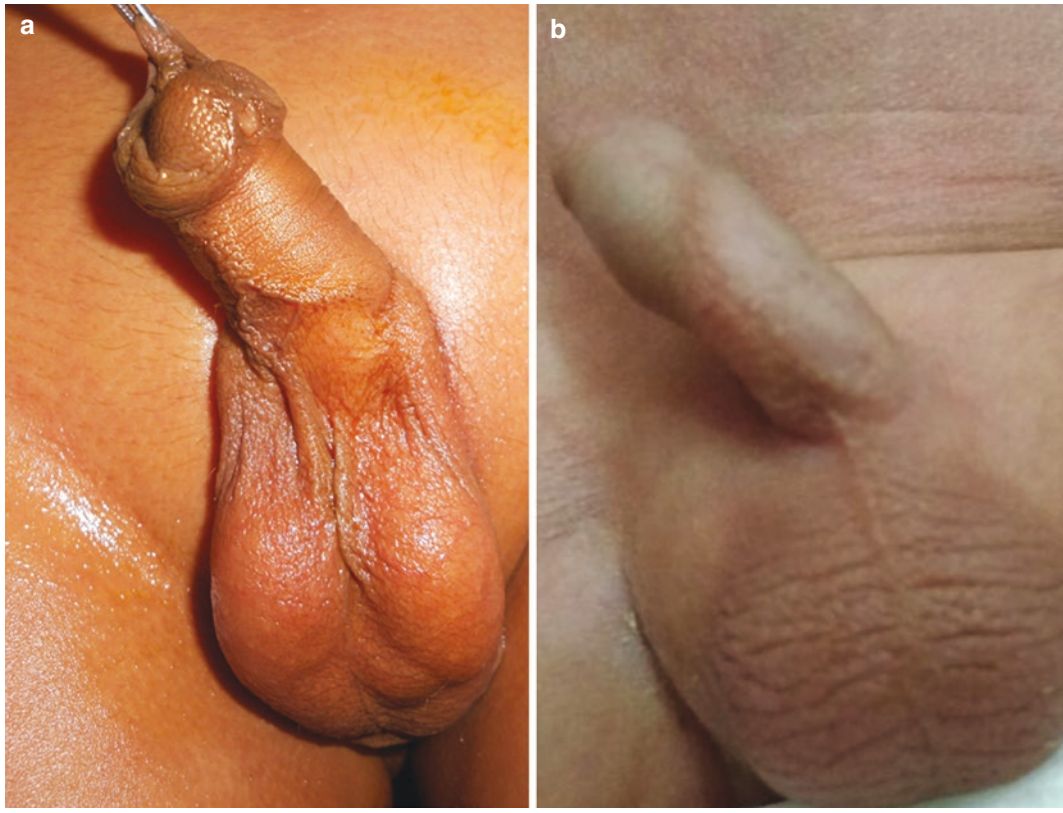


**Fig. 5.2** (**a**) Torsion and deviation of median raphe in hypospadias. (**b**) Torsion and deviation of median raphe in isolated penile torsion

planning of surgical treatment, and co-operation of the family. Sometimes hypospadias may be associated with meatal stenosis. The meatal dilatation is required to prevent infection and back-pressure damage of the urinary tract during the first examination itself. The choice of surgery depends on the developmental milestones, penile length, size of glans, child's response to surgery, toilet training, and anaesthesia risk. The ideal age for hypospadias and genital surgery is 6 to 12 months, as per American Academy of Pediatrics guidelines [8]. The child develops good tolerance to surgery and anaesthesia by six months and becomes aware of his genitalia and toilet trained at 18 months. And even maybe operated at the age of 4 months if the baby is healthy and have adequate penile length [4]. The child who presents later after 18 months to a hospital, especially in developing countries, may be operated on at any age [9]. The general belief is that complications are lower in early repair. Though we had higher complications in adults (16.67%) than paediatric patients (6.67%) in tubularized and TIPU repairs, there is inconsistency in the literature. The issue of aesthetical genital surgeries without a functional impairment in minor hypospadias should be postponed to an age where he can give informed consent without a functional impairment of raising concern. Still, literature shows most of the surgeons are operating at an early age.

## 5.6 Hormonal Stimulation

Though the androgens increase the length of the penis, they improve the urethral plate tissue quality and have been used for a long time. But there is a lack of consensus on the type of androgen, whether local or systemic and the correct way of

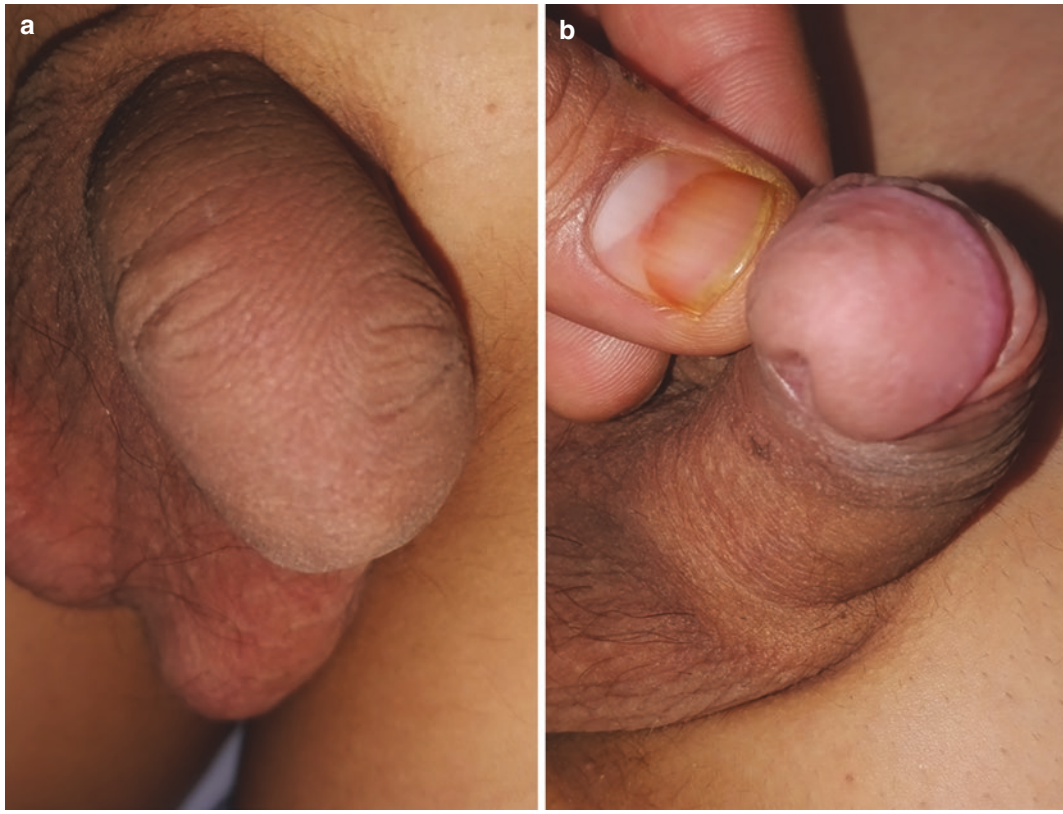


**Fig. 5.3** (**a**). Site of dorsal Bull's eye. (**b**). Site of bifurcation of spongiosum ventrally

application. A thorough study of the potential side effects of androgens is needed. The real benefit of it in hypospadias surgery and the long-term effects of male sexual hormone application still needs to be defined [10]. The best-suited hormone for patients with undescended testis is HCG. Beta HCG, testosterone, and dihydrotestosterone are also used in the small penis or small penis after surgery. But it is unclear how safe these treatments are in the long term. HCG should be used cautiously as the experimental micropenis model supports delaying hormonal therapy until puberty [11]. Local 5% testosterone cream twice a day for five weeks or systemic testosterone two injections a week for five weeks (Koff's regimen) is preferred by most paediatric urologists. We use the local testosterone cream and found it effective in increasing the penile length, vascularity, and thickness of the corpus spongiosum significantly. Recently some studies have reported that androgen stimulation may impair wound healing and increases the risk of postoperative complications. Snodgrass (2014) compared the results of surgery in patients pre-treated with testosterone (to increase the glans size to 15 mm) and without hormones. He reported significantly higher complications and urethrocutaneous fistula in testosterone-treated patients [12].

## 5.7 Optical Magnification

Proper dissection and accurate approximation of tissues is the key to success in hypospadias surgery. The suture material should be very fine to prevent micro fistulae, and subcuticular sutures are preferred. Proper approximation of the tissue in hypospadias surgery is very important. So, magnification becomes an essential tool in these small children [10]. High powered glasses, magnification loupe, and operating microscope are used for magnification. Most hypospadias surgeons are using loupe, and a few prefer the operating microscope. Magnification minimizes complications

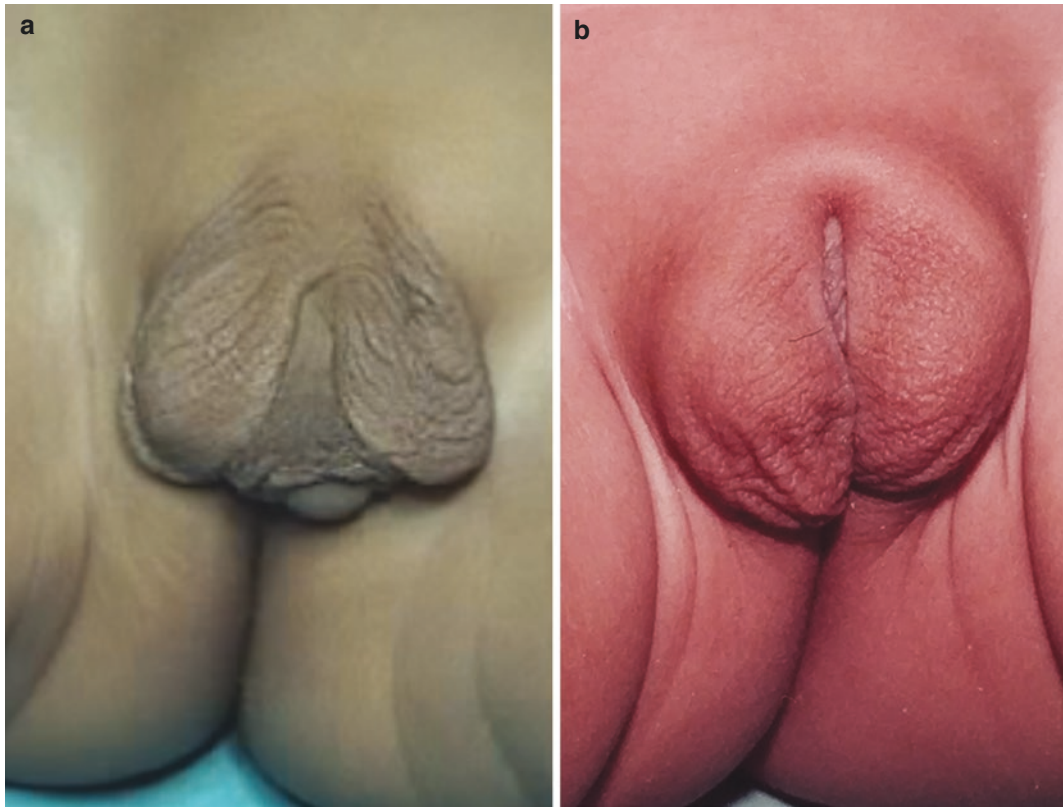


**Fig. 5.4** (**a** & **b**). Severe hypospadias with penoscrotal transposition

and is indispensable in infants and toddlers' surgery. Gilbert et al. experienced fewer complications when using the microscope, and only 6.5% required reoperations in the microscope group while 24% in the non-microscope group [13]. A head-mounted microscope has been utilized in hypospadias surgery with a reported decrease in complications. Although this may provide magnification, there is no evidence to prove that it is more ergonomic than the surgical microscope. But authors prefer to use the magnification loupe rather than a head-mounted microscope or operating microscope for magnification.

## 5.8 Anaesthesia and Analgesia

After the preoperative assessment, a premedication is given to make the child comfortable. Midazolam 0.5 mg/kg IM/IV 30 minutes before surgery is commonly used. General anaesthesia is preferred with or without caudal or local penile block. The caudal block with bupivacaine, clonidine, ketamine, and midazolam is reported to have an increased duration of analgesia in the postoperative period. But there are divided opinions on the better efficacy over each other. In a recent meta-analysis (Goel et al. 2019 [14] and Tanseco et al. 2019 [15]), it was concluded that caudal analgesia might increase the risk of urethrocutaneous fistula and other complications of urethroplasty. The risk of urethrocutaneous fistula increased up to 14.6%, while overall urethroplasty-related complications up to 6.4% in the caudal analgesia patients. The explanation for the increase in complication given was a significant increase in penile volume after caudal block, which is likely to increase penile oedema and causing inadequate or delayed wound healing. But Braga et al. 2017 questioned the hypothesis of penile engorgement resulting in impaired postoperative healing and complications as they

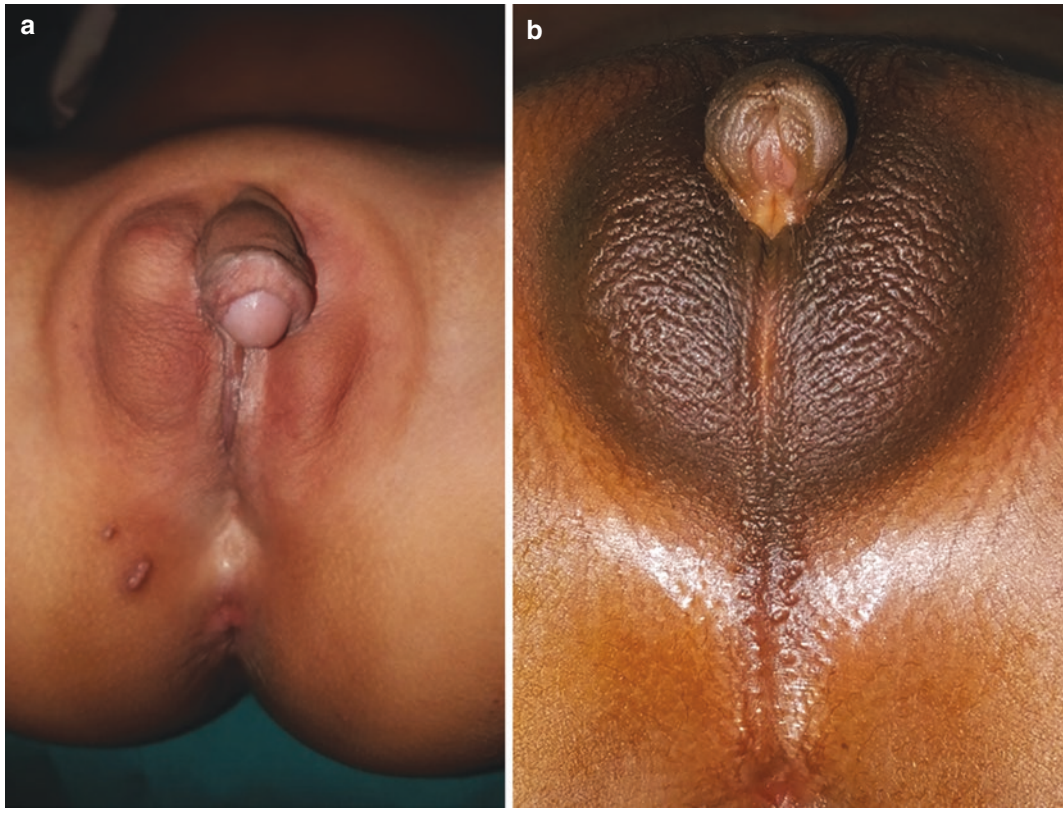


**Fig. 5.5** (**a**) Perineal dimple and small left testis. (**b**) Bifurcation of median raphe

found no increased complications in hypospadias repair with caudal block analgesia [16]. Another study by the Philadelphia group 2018 found no association of the increased complications following caudal anaesthesia, including urethracutaneous fistula and glans dehiscence. The author is also of the same opinion.

## 5.9 Gentle Tissue Handling

Application of all the plastic and reconstructive surgical principles can yield better results in hypospadias repair. Minimal tissue trauma, pinpoint and minimal use of cautery, good haemostasis, tension-free closure in all layers, multiple layer well-vascularized tissue closure, and suturing with epithelial inversion [7]. The use of microsurgical instruments, magnification, proper handling of the tissues by using skin hooks, stay sutures minimize the tissue trauma. Using bipolar electro-cautery with fine tip forceps reduces tissue trauma. Needle holders and micro mosquito forceps should be reserved for hypospadias surgery, where a 6/o-7/o suture is used. Recently Riquelme et al. (2012) developed a new retractor for hypospadias surgery to minimize the tissue trauma, which has the following characteristics, can stabilize the penis in a position, easy to change the position of the penis, can be adjusted for the size of the penis, and maintains the bloodless field [17]. Dissection of the tissues in the right plane preserves the vascularity of the flap for neourethra and skin and helps prevent ischaemic complications. The plane of dissection is kept at Buck's fascia while penile de-gloving is done, and superficial and deep layers of the dartos fascia for raising the inner prepucial flap (Fig. 5.6a, b). A dissection plane is created to mobilize the urethral plate at the level of tunica albuginea, lifting Buck's fascia starting proximal to the meatus in the normal urethra and then dis-

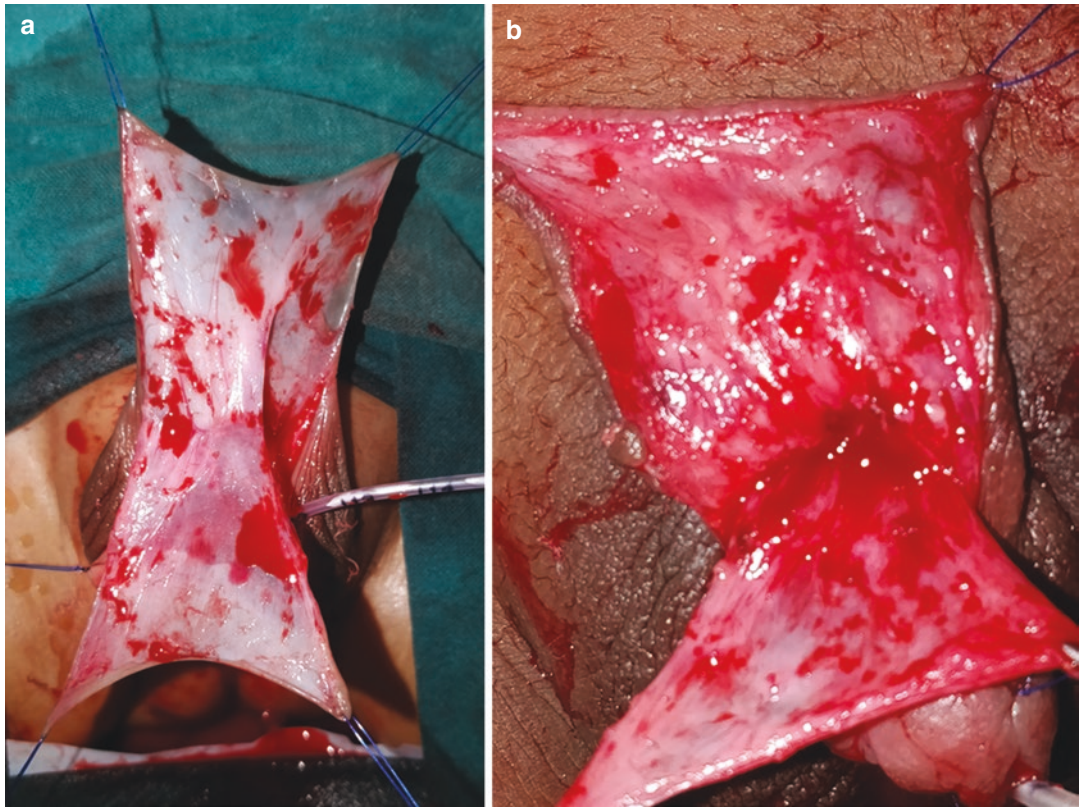


**Fig. 5.6** (**a** & **b**) Dissection of dorsal dartos between the superficial and deep layer of dartos

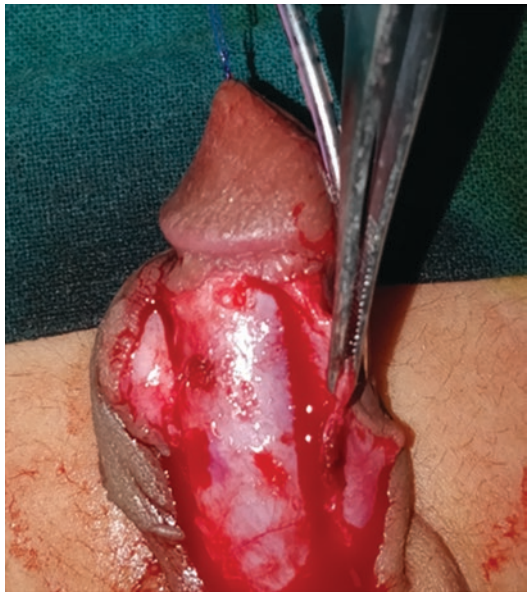

**Fig. 5.7** Plane of dissection of spongiosum with urethral plate

sected in the same plane distally (Fig. 5.7). As the urethra is covered in two layers of Buck's fascia, it is easy to create the plane of dissection without damaging the corpus spongiosum and cavernosum. The glanular wings are incised in the same plane in continuity with corpus spongiosum into the glans (Fig. 5.8a, b).

## 5.10 Suture Material

Ideal suture material for urethroplasty in hypospadias repair should be absorbable and have good tensile strength for a period long enough to resist urinary flow after catheter removal till definitive healing occurs. Skin closure sutures should preferably be absorbable to prevent the anxiety and fear of the patients of suture removal. Though chromic catgut, the natural fibre suture, has been commonly used for urethroplasty in

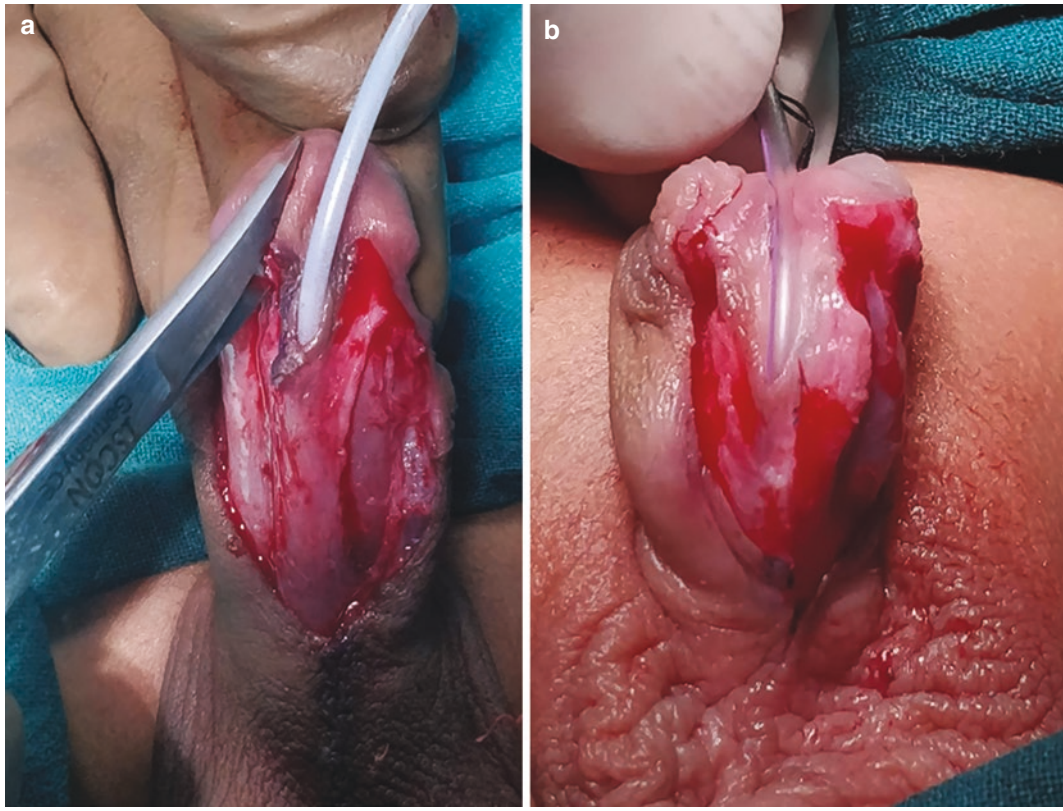


**Fig. 5.8** (**a** & **b**). Dissection of spongiosum into the glans

hypospadias repair for many years, recent studies have shown a higher incidence of urethral fistula compared to polyglactin in tubularized urethral plate urethroplasty for mid-shaft to proximal hypospadias repair and a higher incidence of suture tracks when used for skin reconstruction. Snodgrass found a higher incidence of skin tracks (43%) in patients operated on using chromic catgut [18]. Recently, the monofilament Polydioxanone (PDS) and braided polyglactin (Vicryl), the late absorbable suture, are commonly used in either a continuous subcuticular and interrupted full-thickness fashion with 6/0–7/0 sutures. Larger and nonabsorbable sutures may leave behind the suture marks with comedo-like skin tracks. The size & the composition of suture material, and the type of sutures may affect the outcome of the hypospadias surgery. Ulman and co-workers reported a significantly low fistula rate (4.95%) in subcuticular repair than through and through technique (16.6%) [19]. While others believe subcuticular or through and through sutures does not affect the results provided, polyglactin suture is used [20]. The polyglactin absorbable sutures are useful for the innermost layer closure with epithelial inversion, while polyglyconate sutures are better for other layers. Shirazi et al., in an experimental study in the rats, compared the results Chromic, catgut, polydioxanone, poliglecaprone 25, polylactic acid, and polyglactin [21]. These were reported to have been associated with more vessel density and a wider urethral lumen with poliglecaprone 25, while the polydioxanone had more urethral epithelium. The authors believe that the key to success lies in the accurate approximation of the margin of the urethral plate or skin rather than the type of sutures and suture material. Suppose a surgeon wants to pass the suture through and through urethral plate epithelium or skin, then early absorbable suture like Vicryl rapid should be used, and for subcuticular suturing, any of the

absorbable or late absorbable suture material can be used [22].

## 5.11 Urinary Diversion

Common practice in hypospadias surgery is to use a stent for urinary drainage for 5–7 days, but some use a suprapubic urinary diversion with a urethral stent. There are reports where no stents were utilized without compromising the results of hypospadias repair. Hakim et al., in a multicentric retroscopic review of Mathieu's repair, found no difference in urethrocutaneous fistula rate in stented versus non-stented repair and no urinary retention even in caudal anaesthesia group postoperatively [20]. Waterman et al. (2002) had used stent free repair successfully in modified incised plate tubularized urethroplasty, while Manzoni et al. reported a high fistula rate when the urethral stent was not used [7, 23]. Another issue that remains to be decided is whether the stent is placed in the bladder or urethra. In our opinion, placing the stent in the bladder is better to avoid extravasation of urine than urethral positioned stents. There is no clearly defined suitable size of the urethral stent in urethroplasty. Commonly 5 to 10 Fr size urethral stent according to the age and size of the urethra is used. Reconstructed neourethra is generally larger than or equal to the calibre of the urethral stent. We prefer a Silastic catheter of adequate size according to the child's age and keep it just inside the bladder for about 7–10 days [22]. Hypospadias surgery is usually done in a daycare centre at most places, and the child is sent home the same day after putting the stent in the diapers.

## 5.12 Dressing

There are different opinions about postoperative dressings like whether to go for dressing or not and whether to use the pressure dressing or not. An ideal dressing should be easily and quickly applied, dressing material must be non-allergenic and cheap, should not be adherent to the wound/incision, effectively absorb the leakages of the wound, put adequate pressure on the flaps and grafts effectively without damaging the blood circulation, protect against infections, and must be easily & painlessly removable. In a prospective trial, Van Savage et al. (2000) found no difference in surgery results, rate of adverse events and complications in patients with dressing and no dressing, and it was an easy postoperative ambulatory parent care at home [24]. Multi-layer fibrin glue has been used as an effective dressing as it is impervious to urine and stool and prevents oedema and haematoma. Many other techniques that have been found suitable in hypospadias surgery are SANAV polyurethane bio-occlusive foil, Peha-Haft and adhesive membrane dressings, Cavi care, and glove-finger Melolin. Silicon foam dressing effectively restricts oedema, haematoma formation and stabilization with easy removal [25]. A pressure dressing is a double-edged sword as excessive pressure may compromise the blood supply of skin flaps and skin, while no pressure is likely to lead to haematoma formation, oedema and infection, increasing the incidences of complications. The authors prefer postoperative dressing with optimum pressure to control postoperative oedema, prevent haematoma, and as a barrier to infection.

## 5.13 Surgical Treatment

The surgical goals of hypospadias surgery are a straight penis with adequate length, conical glans with a slit-like meatus at the tip, cosmetic symmetry of the glans and penile shaft, projectile stream, reconstructing a urethra of uniform calibre and adequate length, and normal erections; thereby imposing confidence in the child [22]. Orthoplasty, urethroplasty, meatoplasty and glanuloplasty, scrotoplasty and skin cover are needed to achieve the goals. A circumcoronal incision is given 5–7 mm away from the corona to raise para-glanular flaps. The approximation of the para-glanular flaps will reduce the incidence of subcoronal fistula. Orthoplasty is the most cru-

cial milestone before proceeding to urethroplasty in 1-stage repair. The penis has to be straight for a successful repair. Therefore, the complete chordee's correction should be tested by Gittes test on the table before proceeding for the urethroplasty. The methods for correction of the chordee are penile skin de-gloving, mobilization of urethral plate and urethra, extended urethral mobilization, plication procedures, split and roll technique, dorsal plication, penile disassembly and corporoplasty with the graft. Gittes test is commonly used to assess the complete chordee correction. However, intra-corporeal injection of the Alprost and Prostaglandin E1 is very useful for both intra-operative and in follow-up visits to check for curvature correction. Glanuloplasty and meatoplasty are done to reconstruct a conical glans with wide meatus at the tip to produce a projectile stream. The meatoplasty is commonly done with V or W shaped flap. Raising an adequate length of the glanular wing is crucial in meatoplasty and glanuloplasty to prevent pressure on the neourethra and reduce ischaemic complications.

### 5.13.1 Urethroplasty

Penis and glans size, the severity of ventral curvature, type of hypospadias, the width of urethral plate width and spongiosal development, available ventral penile skin proximal to the meatus, hypoplastic urethral length, size, shape, and type of the dorsal hood, and penile shaft skin are important factors for choosing the type of urethroplasty. Urethral plate preservation procedures are preferred because of their better results. The type of urethroplasty can only be decided after chordee correction. TIPU with or without inlay graft and onlay flap urethroplasty can be done in most of the distal and middle hypospadias with minimal chordee or without chordee. An algorithm is proposed to choose the type of urethroplasty in hypospadias without curvature [22] (Fig. 5.9). Results of single-stage and two stages are comparable, and the choice depends on the training and experience of the surgeon in proximal hypospadias [2, 9, 26–29]. The urethral plate should be preserved and utilized to improve the results. Based on the rational approach taking into consideration all the factors influencing the repair, an algorithm is proposed [9, 22, 30] (Chap. 6, Fig. 6.8).

### 5.13.2 Healthy Vascular Tissue Cover

The critical factors for healing are adequate blood supply of the neourethra and waterproof suturing. Healthy vascularized tissue cover over neourethra helps in maintaining blood supply as well as waterproofing. Commonly used healthy and vascularized interposing tissues are corpus spongiosum, dorsal/ventral/lateral dartos flap, tunica vaginalis flaps, and denuded inner prepucial skin. The dorsal dartos vascular pedicle is mobilized up to the root of the penis to avoid penile torque. The tunica vaginalis flaps are very good vascularized tissue to cover the neourethra and yield better results than other tissues. Denuded skin flaps have also been used for results but need complete denudation to prevent buried skin inclusion dermoid. Spongiosum is a well-vascularized and healthy tissue available locally. Spongioplasty is an ideal healthy tissue cover for neourethra and also reconstructs a near-normal urethra [22]. Dartos flap may also be added with spongiosum for a better outcome.

## 5.14 Preputioplasty

Many parents and patients demand prepucial reconstruction for cosmetic appearance. As the circumcision is less acceptable, the prepuce can be saved and utilized to reconstruct the prepuce and have good cosmetic results [31]. Preputioplasty can be done in both distal and proximal hypospadias in tubularized urethral plate urethroplasty on parents' demand. The foreskin reconstruction adds about 20 minutes to the operating time without increasing the complication of urethroplasty. However, Kljin et al. reported increased urethroplasty complications with preputioplasty and discouraged prepucial

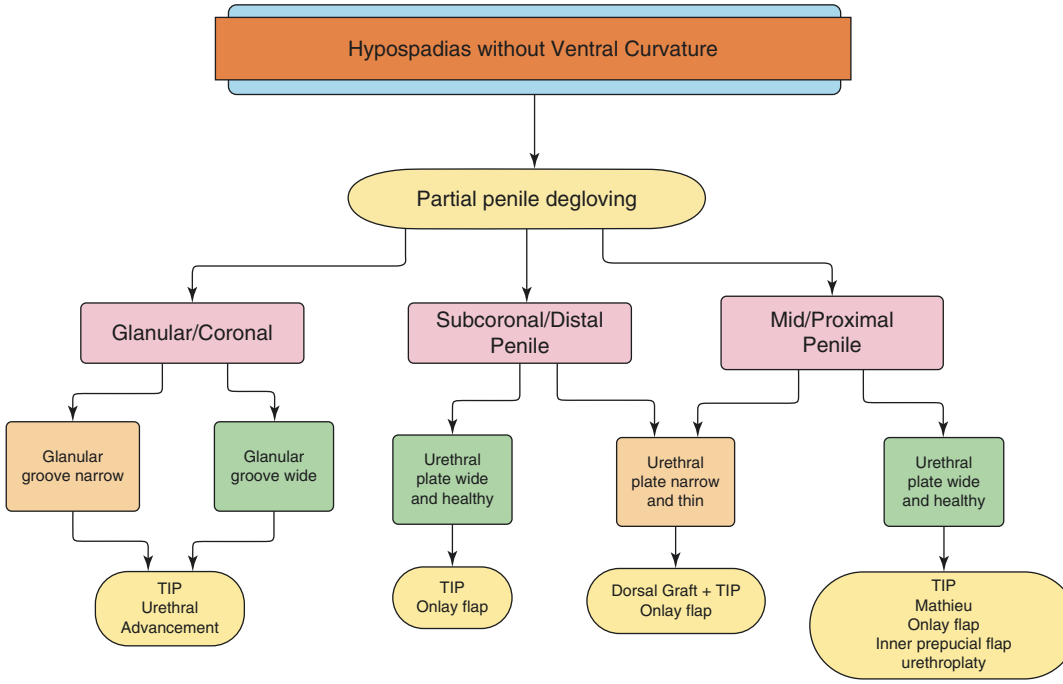


**Fig. 5.9** Algorithm for hypospadias without ventral curvature

reconstruction [32]. But others recommended preputioplasty because they had no difference in urethroplasty results with preputioplasty [26, 31, 33]. Details of prepucioplasty are described in Chap. 25.

## 5.15 Postoperative Care

Dressing, catheter care, analgesics, and antibiotics are the essential points that require attention in the postoperative period. Local anaesthetic agents and acetaminophen or acetaminophen with codeine are needed to relieve the incisional pain. Bladder spasms and related problems can be treated acutely with Oxybutynin in the dose 0.2 mg/kg/dose six hourly. Prophylactic antibiotics should be continued till the per urethral catheter or stent is removed. The parents are counselled for postoperative care and asked to apply an antibiotic ointment to the glans penis and urethra tip every time the diapers are changed or after passing urine.

## 5.16 Postoperative Follow-Up Protocol

Daycare surgery is the routine in hypospadias surgery in most of the centres. Longer hospital and repeated visits of the clinician's may remind the child of his abnormality and have psychological implications. The child is called at 1,3,6 month and then yearly up to 2 years, and review follow-up adolescence to adulthood up to the genital maturity; when the patient can express his social and sexual problems. Any complications beyond two years period will automatically bring the patients to the surgeon. A previous asymptomatic fistula is likely to appear, and chordee may occur due to failure of growth of scarred urethra later. The patients are concerned about the size of the penis and cosmesis. So they should be followed up to adolescence & adulthood for the actual outcome of surgery and real incidence of chronic complications. The post-surgical outcome is

evaluated in view of cosmesis, functional and psychosexual functions. Adult urologists may contribute positively in adolescence and adulthood follow-up and management of the complications.

## 5.17 Surgical Outcome

### 5.17.1 Cosmetic Function

Cosmesis is an important issue in postoperative follow-up. Hypospadiac patients are concerned about the size of the penis and penile appearance. A better cosmetic appearance with an adequate size of the penis yields a better sexual outcome. Hypospadias Objective Scoring Evaluation, Paediatric Penile Perception Score, Hypospadias Objective Penile Evaluation Score are used for objective evaluation of the hypospadiacs. An independent person done scoring, can be kept in the patients' notes for future progression (for details, see Chap. 28).

### 5.17.2 Functional Outcome

Function evaluation of the hypospadiac patients is recommended by the uroflow study after toilet training. Children with findings of borderline obstructed flow, postvoid residual urine, lower urinary tract symptoms, recurrent urinary tract infection, or other urinary signs are evaluated for obstruction & bladder functions. They should be followed until adulthood (for details, see Chap. 28).

### 5.17.3 Psychosexual Outcome

Psychosexual well-being is one of the long-term goals of hypospadias surgery and is a challenge to evaluate. Only a few studies are available for assessing long-term psychosexual adjustment and sexual function. Most hypospadiacs do well in adulthood in terms of sexual function, and the strength and duration of erection, ejaculation, and masturbation are unimpaired. However, in a few patients with severe hypospadias with chordee, long skin urethroplasty, and surgery burden, the sexual functions are affected and concern the patients. They need standardized assessment available for objective scores (for details, see Chap. 27).

## 5.18 Future

Despite innovations and concepts, the importance of the current techniques is unlikely to be obsolete. The innovation and the use of modern technology like laser soldering, tissue engineering, use of Robots and radiological evaluation for chordee tissue, and objective anatomical details will show the pathway to the future of hypospadiology. Tissue engineering may regenerate the urethra for urethral replacement. In experimental studies, the tubular cellular collagen matrices seeded with urothelial cells are used as a medium to grow the urethra and utilized successfully to repair created urethral defects in a rabbit model. Similarly, others have grown the corpus cavernosum [34, 35]. The complex anatomy of the urethral mucosa surrounded by spongiosum is the foremost hurdle to replace the urethra by tissue engineering and its routine use in hypospadias surgery. However, the regenerated urethra can be used in complex redo cases and hypospadias cripple. Robots may play an important role in hypospadias surgery by removing the effects of tremors for meticulous suturing with magnification but have not been used till date.

## References

1. Davis DM. Surgical treatment of hypospadias, especially scrotal and perineal. J Urol. 1951;65(4):595–602.
2. Titley OG, Bracka A. A 5-year audit of trainees experience and outcomes with two-stage hypospadias surgery. Br J Plast Surg. 1998;51(5):370–5.
3. Snyder CL, Evangelidis A, Hansen G, Peter SDS, Ostlie DJ, Gatti JM, Gittes GK, Sharp RJ, Murphy JP. Management of complications after hypospadias repair. Urology. 2005;65(4):782–5.
4. Shukla AR, Patel RP, Canning DA. Hypospadias. Urol Clin. 2004;31(3):445–60.

5. Duckett J, Walsh P, Retik A, Vaughan E. Campbell's urology. Hypospadias. 1998;5:353–95.
6. Khuri F. Urological anomalies associated with hypospadias. Urol Clin North Am. 1981;8:565.
7. Manzoni G, Bracka A, Palminteri E, Marrocco G. Hypospadias surgery: when what and by whom? BJU Int. 2004;94(8):1188–95.
8. Kass EJ, Bolong D. Single-stage hypospadias reconstruction without fistula. J Urol. 1990;144(2 Part 2):520–2.
9. Bhat A. Extended urethral mobilization in incised plate urethroplasty for severe hypospadias: a variation in technique to improve chordee correction. J Urol. 2007;178(3):1031–5.
10. Mouriquand P, Mure PY. Current concepts in hypospadiology. BJU Int. 2004;93:26–34.
11. McMahon D, Kramer S, Husmann D. Micropenis: does early treatment with testosterone do more harm than good? J Urol. 1995;154(2):825–9.
12. Snodgrass W, Villanueva C, Bush NC. Duration of follow-up to diagnose hypospadias urethroplasty complications. J Pediatr Urol. 2014;10(2):208–11.
13. Gilbert DA, Devine CJ Jr, Winslow BH, Horton CE, Getz SE. Microsurgical hypospadias repair. Plast Reconstr Surg. 1986;77(3):460–5.
14. Goel P, Jain S, Bajpai M, Khanna P, Jain V, Yadav DK. Does caudal analgesia increase the rates of urethrocutaneous fistula formation after hypospadias repair? Systematic review and meta-analysis. Indian J Urol. 2019;35(3):222.
15. Tanseco PP, Randhawa H, Chua ME, Blankstein U, Kim JK, McGrath M, Lorenzo AJ, Braga LH. Postoperative complications of hypospadias repair in patients receiving caudal block vs non-caudal anaesthesia: a meta-analysis. Can Urol Assoc J. 2019;13(8):E249.
16. Braga LH, Jegatheeswaran K, McGrath M, Easterbrook B, Rickard M, DeMaria J, Lorenzo AJ. Cause and effect versus confounding—is there a true association between caudal blocks and tubularized incised plate repair complications? J Urol. 2017;197(3 Part 2):845–51.
17. Riquelme M, Aranda A, Rodarte-Shade M, Rodriguez-Gomez J, Torres-Riquelme J. A new surgical stabilizing instrument for hypospadias repair. Eur J Pediatr Surg. 2013;23(02):148–9.
18. Snodgrass W, Bush N. Recent advances in understanding/management of hypospadias. F1000Prime Rep. 2014;6:101. https://doi.org/10.12703/P6-101.
19. Ulman I, Erikci V, Avanoğlu A, Gökdemir A. The effect of suturing technique and material on complication rate following hypospadias repair. Eur J Pediatr Surg. 1997;7(03):156–7.
20. Hakim S, Merguerian PA, Rabinowitz R, Shortliffe LD, McKenna PH. Outcome analysis of the modified Mathieu hypospadias repair: comparison of stented and unstented repairs. J Urol. 1996;156(2):836–8.
21. Shirazi M, Noorafshan A, Serhan A. Effects of different suture materials used for the repair of hypospadias: a stereological study in a rat model. Urol Int. 2012;89(4):395–401.
22. Bhat A. General considerations in hypospadias surgery. Indian J Urol. 2008;24(2):188.
23. Waterman BJ, Renschler T, Cartwright PC, Snow BW, de Vries CR. Variables in successful repair of urethrocutaneous fistula after hypospadias surgery. J Urol. 2002;168(2):726–30.
24. Van Savage JG, Palanca LG, Slaughenhoupt BL. A prospective randomized trial of dressings versus no dressings for hypospadias repair. J Urol. 2000;164(3):981–3.
25. Gangopadhyay A, Sharma S. Brief report-Peha-haft bandage as a new dressing for pediatric hypospadias repair. Indian J Plast Surg. 2005;38(2):162–4.
26. Snodgrass W, Yucel S. Tubularized incised plate for mid-shaft and proximal hypospadias repair. J Urol. 2007;177(2):698–702.
27. Braga LH, Pippi Salle JL, Lorenzo AJ, Skeldon S, Dave S, Farhat WA, Khoury AE, Bagli DJ. Comparative analysis of tubularized incised plate versus onlay island flap urethroplasty for penoscrotal hypospadias. J Urol. 2007;178(4):1451–7.
28. Gershbaum MD, Stock JA, Hanna MK. A case for the 2-stage repair of perineoscrotal hypospadias with severe chordee. J Urol. 2002;168(4 Part 2):1727–9.
29. Ferro F, Zaccara A, Spagnoli A, Lucchetti M, Capitanucci M, Villa M. Skin graft for 2-stage treatment of severe hypospadias: back to the future? J Urol. 2002;168(4):1730–3.
30. Kajbafzadeh A-M, Arshadi H, Payabvash S, Salmasi AH, Najjaran-Tousi V, Sahebpor ARA. Proximal hypospadias with severe chordee: single-stage repair using corporeal tunica vaginalis free graft. J Urol. 2007;178(3):1036–42.
31. Gray J, Boston V. Glanular reconstruction and preputioplasty repair for distal hypospadias: a unique day-case method to avoid urethral stenting and preserve the prepuce. BJU Int. 2003;91(3):268–70.
32. Klijn AJ, Dik P, De Jong TP. Results of preputial reconstruction in 77 boys with distal hypospadias. J Urol. 2001;165(4):1255–7.
33. Erdenetsetseg G, Dewan P. Reconstruction of the hypospadiac hooded prepuce. J Urol. 2003;169(5):1822–4.
34. Kwon TG, Yoo JJ, Atala A. Autologous penile corpora cavernosa replacement using tissue engineering techniques. J Urol. 2002;168(4):1754–8.
35. Atala A. Recent developments in tissue engineering and regenerative medicine. Curr Opin Pediatr. 2006;18(2):167–71.