

3.4.5 **Summary of evidence and recommendations for the management of acute scrotum in children**

Summary of evidence	LE
Diagnosis of testicular torsion is based on presentation and physical exam.	
Doppler US is an effective imaging tool to evaluate acute scrotum and comparable to scintigraphy and dynamic contrast-enhanced subtraction MRI.	2a
Neonates with acute scrotum should be treated as surgical emergencies.	3

Recommendations	LE	Strength rating
Testicular torsion is a paediatric urological emergency and requires immediate treatment.	3	Strong
In neonates with testicular torsion perform orchidopexy of the contralateral testicle. In prenatal torsion the timing of surgery is usually dictated by clinical findings.	3	Weak
Base the clinical decision on physical examination. The use of Doppler ultrasound to evaluate acute scrotum is useful, but this should not delay the intervention.	2a	Strong
Manage torsion of the appendix testis conservatively. Perform surgical exploration in equivocal cases and in patients with persistent pain.	3	Strong
Perform urgent surgical exploration in all cases of testicular torsion within 24 hours of symptom onset. In prenatal torsion the timing of surgery is usually dictated by clinical findings.	3	Strong

3.5 **Hypospadias**

3.5.1 **Epidemiology, aetiology and pathophysiology**

3.5.1.1 *Epidemiology*

The total prevalence of hypospadias in Europe is 18.6 new cases per 10,000 births (5.1-36.8) according to the recent EUROCAT registry-based study. This incidence was stable over the period of 2001 to 2010 [188, 189]. The mean worldwide prevalence of hypospadias according to an extended systematic literature review varies: Europe 19.9 (range: 1-464), North America 34.2 (6-129.8), South America 5.2 (2.8-110), Asia 0.6-69, Africa 5.9 (1.9-110), and Australia 17.1-34.8. There are conflicting data on the recent trends of prevalence – different trends in Europe and an increasing trend in the USA [190, 191].

3.5.2 **Risk factors**

Risk factors associated with hypospadias are likely to be genetic, placental and/or environmental [188, 189] (LE: 2b). Interactions between genetic and environmental factors may help explain non-replication in genetic studies of hypospadias. Single nucleotide polymorphisms seemed to influence hypospadias risk only in exposed cases [189, 192] (LE: 2b).

- An additional family member with hypospadias is found in 7% of families, but this is more predominant in anterior and middle forms [192-195].
- Endocrine disorders can be detected in rare cases.
- Babies with a low birth weight have a higher risk of hypospadias [192-195].
- Over the last 25 years, a significant increase in the incidence of hypospadias has been found.
- Endocrines disruptors are one component of a multi-factorial model for hypospadias.
- The use of oral contraceptives prior to pregnancy has not been associated with an increased risk of hypospadias in offspring, but their use after conception increased the risk of middle and posterior hypospadias [193-196] (LE: 2a).

3.5.3 **Classification systems**

Hypospadias are usually classified based on the anatomical location of the proximally displaced urethral orifice:

- distal-anterior hypospadias (located on the glans or distal shaft of the penis and the most common type of hypospadias);
- intermediate-middle (penile);
- proximal-posterior (penoscrotal, scrotal, perineal).

The pathology may be different after skin release and should be reclassified accordingly. Anatomical location of meatus may not always be enough to explain the severity and the complex nature of this pathology. Therefore, a simple classification related to severity of the problem, which considers penile length, glans size, shape, urethral plate quality and penile curvature is commonly used. In that classification there are two

types: mild hypospadias (glanular or penile isolated hypospadias without associated chordee, micropenis or scrotal anomaly); severe hypospadias (penoscrotal, perineal hypospadias with associated chordee and scrotal anomalies).

3.5.4 **Diagnostic evaluation**

Most hypospadias patients are easily diagnosed at birth (except for the megameatus intact prepuce variant which can only be seen after retraction of foreskin). Diagnosis includes a description of the local findings:

- position, shape and width of the orifice;
- presence of atretic urethra and division of corpus spongiosum;
- appearance of the preputial hood and scrotum;
- size of the penis;
- curvature of the penis on erection.

The diagnostic evaluation also includes an assessment of associated anomalies, which are:

- cryptorchidism (in up to 10% of cases of hypospadias);
- open processus vaginalis or inguinal hernia (in 9-15%).

Severe hypospadias with unilaterally or bilaterally impalpable testis, or with ambiguous genitalia, requires a complete genetic and endocrine work-up immediately after birth to exclude DSD, especially congenital adrenal hyperplasia.

Urine trickling and ballooning of the urethra requires exclusion of meatal stenosis. The relationship between the severity of the hypospadias and associated anomalies of the upper- or lower urinary tract were not confirmed [197] (LE: 3).

3.5.5 **Management**

3.5.5.1 *Indication for reconstruction and therapeutic objectives*

Differentiation between functionally necessary and aesthetically feasible operative procedures is important for therapeutic decision making.

The indications for surgery are:

- proximally located (ectopic) meatus causing ventrally deflected or spraying urinary stream;
- meatal stenosis;
- anterior curvature of the penis;
- cleft glans;
- rotated penis with abnormal cutaneous raphe;
- preputial hood;
- penoscrotal transposition;
- split scrotum.

Physical examination should check all anatomic components of the penis and evaluate the degree and nature of abnormality in each component. The examination should evaluate location of the meatus, the degree of proximal spongiosal hypoplasia, presence and degree of penile curvature, width and depth of the urethral plate, size of the glans, degree of ventral skin deficiency, availability of the foreskin and scrotal abnormalities like penoscrotal transposition and bifid scrotum.

As all surgical procedures carry the risk of complications, thorough pre-operative counselling of the caregiver is crucial.

To achieve an overall acceptable functional and cosmetic outcome, the penile curvature must be corrected and a neo-urethra of an adequate size with opening on the glans formed with proper skin coverage of the penile shaft [198] (LE: 4) (Figure 3). The use of magnifying spectacles and fine synthetic absorbable suture materials (6.0-7.0) are required. As in any penile surgery, exceptional prudence should be adopted with the use of cautery. Bipolar cautery is recommended. Knowledge of a variety of surgical reconstructive techniques, wound care and post-operative treatment are essential for a satisfactory outcome.

3.5.5.2 *Pre-operative hormonal treatment*

There is a lack of high-quality evidence to support that pre-operative hormonal treatment with androgen stimulation improves surgical outcomes. Yet, this treatment in the form of systemic testosterone, topical testosterone, and derivatives like dihydrotestosterone (DHT) and hCG are commonly being used to increase glans size pre-operatively to allow better tubularisation of the urethral plate and decrease the incidence of

glans dehiscence. This treatment is usually limited to patients with proximal hypospadias, a small appearing penis, reduced glans circumference or reduced urethral plate [196, 199, 200]. Studies have shown that it leads to significant enlargement of the glans and shaft of the penis (LE: 1b) [201, 202].

Moderate quality evidence from three randomised studies demonstrate significantly lower rates of urethra-cutaneous fistulae and reoperation rates in patients who received pre-operative hormonal treatment [203].

Pre-operative testosterone administration is most often well tolerated. Transient side effects on child's behaviour, increased genital pigmentation, appearance of pubic hair, penile skin irritation and redness, increased erections and peri-operative bleeding have been reported, but no persistent side effects related to hormonal stimulation have been reported in the literature. There is also no evidence about possible effects on bone maturation [200, 203, 204].

There are concerns regarding the negative impacts of testosterone on wound-healing and increased bleeding during surgery. Cessation of therapy is recommended 1-2 months prior to surgery to avoid adverse effects during or after surgery [205].

3.5.5.3 *Age at surgery*

The age at surgery for primary hypospadias repair is usually 6-18 (24) months [198, 206, 207] (LE: 3). Age at surgery is not a risk factor for urethroplasty complication in pre-pubertal tubularised incised plate urethroplasty (TIP) repair [206] (LE: 2b). Complication rate after primary TIP repair was 2.5 times higher in adults than in the paediatric group according to a recent prospective controlled study [208] (LE: 2a).

3.5.5.4 *Penile curvature*

If present, penile curvature is often released by degloving the penis (skin chordee) and by excision of the connective tissue of the genuine chordee on the ventral aspect of the penis in up to 70% [209]. The urethral plate has well vascularised connective tissue and does not cause curvature in most cases [210, 211]. The residual curvature is caused by corporeal disproportion and requires straightening of the penis, mostly using dorsal midline plication or orthoplasty (modification of the Nesbit plication with or without elevation of the neurovascular bundle). In more severe curvature (> 45°), which is often combined with a short urethral plate requiring transection, ventral penile lengthening is recommended to prevent shortening of the penis. This consists of a ventral transverse incision of tunica albuginea extending from the 3 to 9 o'clock position patched with tunica vaginalis flap or graft, or in several short ventral corporotomies without grafting (LE: 2b) [212]. After the ventral lengthening, a shorter dorsal midline plication is usually added.

According to a retrospective study, dorsal plication remained significantly associated with recurrent ventral curvature independently of the other factors. Ventral corporeal grafting for severe penile curvature gives good long-term results and safety profiles for erectile function [213] (LE: 2b).

3.5.5.5 *Urethral reconstruction*

The mainstay of hypospadias repair is preservation of the well-vascularised urethral plate and its use for urethral reconstruction has become standard practice in hypospadias repair [211]. Mobilisation of the corpus spongiosum/urethral plate and the bulbar urethra decreases the need for urethral plate transection [212] (LE: 2b).

If the urethral plate is wide, it can be tubularised following the Thiersch-Duplay technique. If the plate is too narrow to be simply tubularised, it is recommended relaxing the plate by a midline incision and its subsequent tubularisation according to the Snodgrass-Orkiszewski TIP technique. This technique has become the treatment of choice in distal and mid-penile hypospadias [214-217]. If the incision of the plate is deep, it is recommended to cover the raw surface with inner preputial (or buccal) inlay graft in primary and secondary repairs [218]. This also enables extension of the incision beyond the end of the plate to prevent meatal stenosis [219, 220] (LE: 2a).

For distal forms of hypospadias, a range of other techniques is available (e.g. Mathieu, urethral advancement) [221] (LE: 2b). The TIP technique has become an option for proximal hypospadias as well [214-217, 222]. However, urethral plate elevation and urethral mobilisation should not be combined with TIP repair because it results in focal devascularisation of the neo-urethra with symptomatic stricture development [223] (LE: 2b). The onlay technique using a preputial island flap is a standard repair, preferred in proximal hypospadias, if a plate is unhealthy or too narrow [209]. An onlay preputial graft is an option for single-stage repair [224] (LE: 2b).

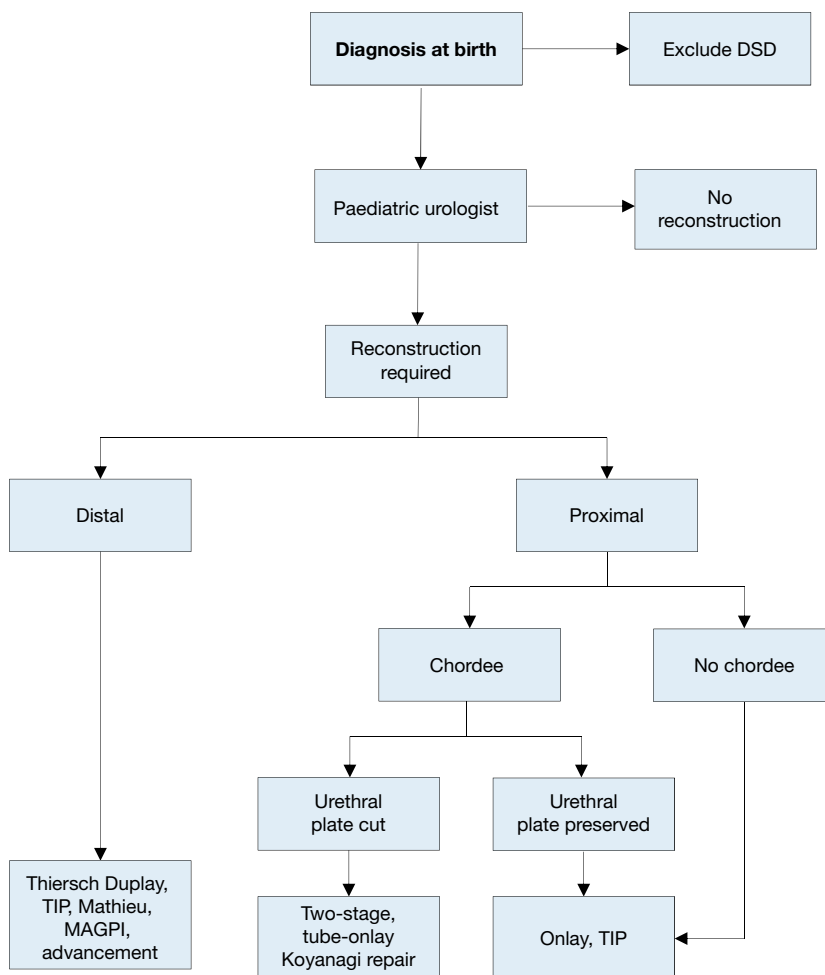
If the continuity of the urethral plate cannot be preserved, single or two-stage repairs are used. For the former, a modification of the tubularised flap (Duckett tube), such as a tube-onlay or an inlay-onlay flap, or onlay flap on albuginea are used to prevent urethral stricture [225-227] (LE: 3); alternatively the Koyanagi-Hayashi

technique is used [228-231]. The two-stage procedure has become preferable over the past few years because of lower recurrence of ventral curvature and more favourable results with variable long-term complication rate [220, 225, 232-236].

3.5.5.6 Re-do hypospadias repairs

For re-do hypospadias repairs, no definitive guidelines can be given. All the above-mentioned procedures are used in different ways and are often modified according to the individual findings and needs of the patient.

Figure 3: Algorithm for the management of hypospadias



DSD = disorders of sex development; GAP = glans approximation procedure; TIP = tubularised incised plate urethroplasty; MAGPI = meatal advancement and glanuloplasty incorporated.

3.5.5.7 Penile reconstruction following formation of the neo-urethra

Following formation of the neo-urethra, the procedure is completed by glansplasty and by reconstruction of the penile skin. If there is a shortage of skin covering, the preputial double-face technique or placement of the suture line into the scrotum according to Cecil-Michalowski is used. In countries where circumcision is not routinely performed, preputial reconstruction can be considered. Preputial reconstruction carries a risk of specific complications but does not seem to increase the risk of urethroplasty complications [237]. In TIP repair, the use of a preputial dartos flap reduces the fistula rate [214, 215] (LE: 2b).

3.5.5.8 Urine drainage and wound dressing

Urine is drained transurethrally (e.g. dripping stent) or with a suprapubic tube. No drainage after distal hypospadias repair is another option [238, 239]. Circular dressing with slight compression, as well as prophylactic antibiotics during surgery, are established procedures [239] (LE: 4). Post-operative prophylaxis after hypospadias repair is controversial [240, 241] (LE: 2b). There is no consensus on duration of stenting and dressing.

3.5.5.9 Outcome

Some studies have tried to determine risk factors for complications after hypospadias repair. An analysis of prospectively collected data found glans size (width < 14 mm), proximal meatal location and re-operation as independent risk factors for urethral complication [239, 242]. Low surgeon volume independently increases the risk of fistula, stricture or diverticulum repair [239, 243] (LE: 3).

A meta-analysis of complication rates of TIP repair found lower complication rate and incidence of re-operations in primary distal repairs (in 4.5%) than in primary proximal repairs (in 12.2%) and in secondary repair (in 23.3%) [214-217, 222, 239]. One should expect a predictable outcome with complication rates below 10% in distal hypospadias (fistula, meatal stenosis, dehiscence, recurrent ventral curvature, and haematoma) [243, 244]. A similar incidence of fistula (3.4-3.6%) can be expected after the Mathieu and TIP repairs of distal hypospadias [222, 245, 246].

The complication rate of TIP and onlay repairs of primary severe hypospadias is similar, 24% and 27%, respectively. It is higher in free graft and in preputial island tube urethroplasty [209]. The complication rate of single-stage Koyanagi and Hayashi modification repairs goes up 61%, according to a comparative study [228, 239]. Staged buccal mucosa graft requires a redo grafting in 13% of patients, after the second stage more than one third of patients have complications, mostly with some degree of graft fibrosis [246, 247]. A recent long-term study on two-stage flap repair showed a complication rate of 68% [239], another study showed a re-operation rate of 28% [220, 239].

3.5.6 Follow-up

Long-term follow-up is necessary up to adolescence to detect urethral stricture, voiding dysfunctions and recurrent penile curvature, diverticula, glanular dehiscence [248]. Up to half of complications requiring re-operation present after the first year post-operatively [249] (LE: 2b).

Obstructive flow curve is common after hypospadias repair and while most are not clinically significant, long-term follow-up is required [250-253] (LE: 2a). Urine flow is significantly lower in patients after hypospadias surgery, especially in those who had corrected chordee, but without significant association with lower urinary symptoms [254] (LE: 2a).

Objective scoring systems have been developed in order to evaluate the results of hypospadias surgery (HOSE) [255] (LE: 2b) and cosmetic appearance (HOPE-Hypospadias Objective Penile Evaluation) [256] (LE: 2a). The Pediatric Penile Perception Score (PPPS) is a reliable instrument to assess penile self-perception in children after hypospadias repair and for appraisal of the surgical result by caregivers and uninvolved urologists [257] (LE: 2a). The surgeon should admit that cosmetic results were judged more optimistically by surgeons as compared to caregivers using validated tools [258]. Current scoring systems have deficiencies in terms of patient reported outcomes, the long term outcomes and sexual function [259].

Adolescents and adults, who have undergone hypospadias repair in childhood, have a slightly higher rate of dissatisfaction with penile size, especially proximal hypospadias patients, but their sexual behaviour is not different from that of control groups [260, 261] (LE: 2a-b). Another long-term follow-up of men born with hypospadias revealed, in a controlled study, that these patients are less satisfied with penile cosmetic outcome according to all parameters of the PPPS, there was a difference in penile length (9.7 vs. 11.6 cm) and more patients had lower maximum urinary flow, and more prominent results were found in proximal hypospadias vs. controls [239, 262].

According to a systematic review of long-term patient satisfaction with cosmetic outcomes [263]:

- patient perception of penile size does not differ greatly from the norm;
- patients approaching puberty have a more negative perception and are more critical about the cosmetic outcomes of surgery;
- patients report high levels of perception of deformity and social embarrassment.

The majority of identified instruments focused on postoperative cosmetic satisfaction, with only one instrument considering urinary function, and no instruments evaluating sexual function and psychosocial sequelae [264].

3.5.7 Summary of evidence and recommendations for the management of hypospadias

Summary of evidence	LE
The suggested age at surgery for primary hypospadias repair is 6 - 18 (24) months.	3
The therapeutic objectives are to correct the penile curvature, to form a neo-urethra of an adequate size, to bring the new meatus to the tip of the glans, if possible, and to achieve an overall acceptable cosmetic appearance.	4
Androgen stimulation therapy results in increased penile length and glans circumference.	1b
The complication rate is about 10% in distal and 25% in proximal hypospadias one-stage repairs. Higher and variable rates (between 28 and 68%) can occur in two-stage repairs.	3
Sexual functions are usually well preserved but patients report high levels of perception of deformity and social embarrassment.	2b

Recommendations	Strength rating
At birth, differentiate isolated hypospadias from disorders of sex development which are mostly associated with cryptorchidism or micropenis.	Strong
Counsel caregivers on functional indications for surgery, aesthetically feasible operative procedures (psychological, cosmetic indications) and possible complications.	Strong
In children diagnosed with proximal hypospadias and a small appearing penis, reduced glans circumference or reduced urethral plate, pre-operative hormonal androgen stimulation treatment is an option and the body of evidence to accentuate its harms and benefits is inadequate.	Weak
For distal hypospadias, offer Duplay-Thiersch urethroplasty, original and modified tubularised incised plate urethroplasty; use the onlay urethroplasty or two-stage procedures in more severe hypospadias. A treatment algorithm is presented (Figure 3). Correct significant (> 30 degrees) curvature of the penis.	Weak
Ensure long-term follow-up to detect urethral stricture, voiding dysfunctions and recurrent penile curvature, ejaculation disorder, and to evaluate patient's satisfaction.	Strong
Use validated objective scoring systems to assist in evaluating the functional and cosmetic outcome.	Strong

3.6 Congenital penile curvature

3.6.1 Epidemiology, aetiology and pathophysiology

Congenital penile curvature presents penile bending of a normally formed penis due to corporal disproportion. The incidence at birth is 0.6% and congenital penile curvature is caused by asymmetry of the cavernous bodies and an orthotopic meatus [265] because of developmental arrest during embryogenesis [266]. On the other hand, the incidence of clinically significant congenital penile curvature is much lower, because the extent of the curvature and its associated sexual dysfunction varies widely [267]. Most of the cases are ventral deviations (48%), followed by lateral (24%), dorsal (5%), and a combination of ventral and lateral (23%) [268]. Most ventral curvatures are associated with hypospadias due to chordee or ventral dysplasia of cavernous bodies [269]. Similarly, dorsal curvature is mostly associated with exstrophy/epispadias complex.

Curvature > 30° is considered clinically significant; curvature > 60° may interfere with satisfactory sexual intercourse in adulthood (LE: 4). Minor penile curvature may be the result of ventral penile skin deficiency only and should be distinguished from corporal anomalies. For penile curvature associated with hypospadias or epispadias refer to the relevant chapters.

3.6.2 Diagnostic evaluation

Penile curvature is frequently not documented until later in childhood since the penis only appears abnormal when erect. Patients are usually concerned with the aesthetic and/or functional aspects of their penis [270]. Besides exact history taking to exclude any possibility of acquired penile curvature (e.g. post-traumatic) a thorough clinical examination is mandatory. In addition, photo documentation of the erect penis clearly showing the curvature from different angles serves as a pre-requisite in preoperative evaluation [271]. The exact degree of curvature is generally determined at the time of surgery using an artificial erection test.

3.6.3 Management

The treatment is surgical, starting with an artificial erection to determine the degree of curvature and to check symmetry after the repair [272]. The ultimate goal of any surgical method used to correct the curvature