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European Association of Urology

Guidelines – Reconstructive Urology

EAU Guidelines on Urethral Trauma

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Abstract

Context: These guidelines were prepared on behalf of the European Association of Urology (EAU) to assist urologists in the management of traumatic urethral injuries.

Objective: To determine the optimal evaluation and management of urethral injuries by review of the world's literature on the subject.

Evidence acquisition: A working group of experts on Urological Trauma was convened to review and summarize the literature concerning the diagnosis and treatment of genitourinary trauma, including urethral trauma. The Urological Trauma guidelines have been based on a review of the literature identified using on-line searches of MEDLINE and other source documents published before 2009. A critical assessment of the findings was made, not involving a formal appraisal of the data. There were few high-powered, randomized, controlled trials in this area and considerable available data was provided by retrospective studies. The Working Group recognizes this limitation.

Evidence synthesis: The full text of these guidelines is available through the EAU Central Office and the EAU website (www.uroweb.org). This article comprises the abridged version of a section of the Urological Trauma guidelines.

Conclusions: Updated and critically reviewed Guidelines on Urethral Trauma are presented. The aim of these guidelines is to provide support to the practicing urologist since urethral injuries carry substantial morbidity. The diversity of urethral injuries, associated injuries, the timing and availability of treatment options as well as their relative rarity contribute to the controversies in the management of urethral trauma.

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1. Introduction

The European Association of Urology (EAU) Guidelines Group for Urological Trauma has prepared a guidelines document to assist medical professionals in the diagnosis and management of urological trauma. The Urological Trauma Guidelines were first published in 2003, with a partial update in 2006 followed by a full text update in 2009.

2. Evidence acquisition

The 2009 update of the Urological Trauma guidelines was based on a critical review of the literature, using on-line searches of MEDLINE and other source documents published before 2009. There is a lack of high-powered, randomized, controlled trials in this area and much available data are based on retrospective studies. The Guidelines Group recognizes this limitation.

In this article, the Guidelines Group for Urological Trauma present a condensed version of the section on urethral trauma. The full Guidelines text can be viewed and downloaded for personal use at the society website: http://www.uroweb.org/professional-resources/guidelines/.

3. Evidence synthesis

3.1. Diagnosis and classification

Injuries to the anterior urethra are caused by blunt or penetrating trauma [1,2–4], placement of penile constriction bands, and iatrogenic injuries from instrumentation.

Injuries to the posterior urethra occur with pelvic fractures, mostly as a result of motor vehicle accidents [5,6]. Injuries vary from simple stretching (25%) to partial rupture (25%) to complete disruption (50%) [6] (level of evidence: 3).

Urethral injuries in women are rare. Urethral injuries in children are similar to those in adults, although injuries to the prostate and bladder neck may be more common [1,6–8].

The classification provided in Table 1 combines the best of previous classifications and has direct implications for clinical management. As with other newer classifications, it provides both an anatomical classification and a means of comparing treatment strategies and outcomes [9,10]. The injury grade provides a guide to clinical management.

3.1.1. Clinical assessment

A diagnosis of acute urethral trauma should be suspected from the history. A pelvic fracture, or any external penile or perineal trauma, can suggest urethral trauma [11,12]. A high-riding prostate at digital rectal examination is an unreliable finding, but is nevertheless important to perform to exclude a concomitant rectal injury.

In the absence of blood at the meatus or penile haematoma, urethral injury is very unlikely and can be excluded by catheterization. However, blood at the meatus is associated with urethral injury and urethral instrumentation should be avoided until the urethra is imaged.

In an unstable patient, it may be necessary to attempt to pass a urethral catheter. If there is any difficulty, a suprapubic catheter should be inserted under ultrasound guidance and a retrograde urethrogram performed later. In

Table 1 – Classification of blunt anterior and posterior urethra with management according to injury grade

Grade	Description	Appearance	Management
I	Stretch injury	Elongation of the urethra without extravasation on urethrography	No treatment required
II	Contusion	Blood at the urethral meatus; no extravasation on urethrography	Grades II and III can be managed conservatively with suprapubic cystostomy or urethral catheterization
III	Partial disruption	Extravasation of contrast at injury site with contrast visualized in the proximal urethra or bladder	
IV	Complete disruption	Extravasation of contrast at injury site without visualization of proximal urethra or anterior urethra or bladder	Suprapubic cystostomy and delayed repair or primary endoscopic realignment in selected patients ± delayed repair
V	Complete or partial disruption of posterior urethra with associated tear of the bladder neck, rectum or vagina	Extravasation of contrast at urethral injury site ± presence of blood in the vaginal introitus in women. Extravasation of contrast at bladder neck during suprapubic cystography ± rectal or vaginal filling with contrast material	Primary open repair

Table 2 – Signs that require complete urethral evaluation

Sign	Comment
Blood at the meatus	Present in 37–93% of patients with a posterior urethral injury, and in at least 75% of patients with an anterior urethral injury. Avoid urethral instrumentation until the urethra is imaged
Blood at the vaginal introitus	Present in more than 80% of female patients with pelvic fractures and co-existing urethral injuries
Haematuria	Although non-specific, haematuria on a first voided specimen may indicate urethral injury. It should be noted that the amount of urethral bleeding correlates poorly with the severity of injury
Pain on urination or inability to void	Either symptom suggest urethral disruption
Perineal/penile haematoma or labial swelling	

cases of successful urethral catheterization, the correct placement of the Foley balloon catheter inside the bladder must be checked radiographically or with ultrasound once the patient has been stabilized.

In penetrating injuries, the type of weapon used, including the calibre of the bullet, helps to assess potential tissue damage. In a conscious patient, a thorough voiding history should be obtained to establish the time of last urination, the force of the urinary stream, whether urination is painful and whether haematuria is present. The presence of any clinical indicator of acute urethral trauma (Table 2) requires a complete urethral evaluation (level of evidence: 3).

3.1.2. Radiographic examination

Dynamic retrograde urethrography is the gold standard for evaluating urethral injury [4,13]. The radiographic appearance of the urethra permits classification of the injury and guides subsequent management. Additional x-ray investigations, such as a whole-body computed tomography (CT) scan, are often indicated for associated injuries in polytrauma patients.

If posterior urethral injury is suspected, a suprapubic catheter is inserted and a cystogram performed to exclude bladder-neck injuries. A simultaneous cystogram and ascending urethrogram can be carried out later to assess the site, severity and length of injury as well as the function of the bladder neck, and is usually done after 3 mo if a delayed repair is considered.

When the proximal urethra is not visualized in a simultaneous cystogram and urethrogram, either magnetic resonance imaging (MRI) of the posterior urethra [14] or endoscopy through the suprapubic tract can be used.

Computed tomography and MRI have no place in the initial assessment of urethral injuries (level of evidence: 3).

3.1.3. Endoscopic examination

Urethroscopy has no role in the initial diagnosis of posterior urethral trauma in males. However it may provide useful information in the evaluation of partial disruptions of the distal anterior urethra.

In females, urethroscopy may be an important adjunct for the identification and staging of urethral injuries [15] (level of evidence: 4).

4. Management

Management of urethral injuries remains controversial due to the variety of injury patterns, associated injuries and treatment options. In addition, most urologists have little experience with these injuries and there is a lack of randomized prospective trials.

4.1. Female urethral injuries

These often occur together with bladder ruptures and can be repaired at the same time. A transvesical approach is best for proximal urethral injuries and a vaginal approach for distal injuries [4]. Post-traumatic urethral fistulae can also be repaired transvaginally [16,17] (level of evidence: 4).

4.2. Male anterior urethral injuries

4.2.1. Blunt injuries

Partial tears can be managed with a suprapubic catheter or with urethral catheterization [4,18,19]. Suprapubic cystostomy has the benefit of avoiding urethral manipulation, which can produce further urethral trauma [20] and allows for a simultaneous study to be carried out later. If the bladder is not easily palpable suprapubically, insert the catheter using transabdominal sonography (level of evidence: 4).

The cystostomy tube is maintained for about 4 wk to allow urethral healing. The suprapubic tube is removed if normal voiding can be re-established and neither contrast extravasation nor stricture is present.

Early complications of acute urethral injuries include strictures and infections.

Extravasated blood or urine from the urethral tear and semen from nocturnal ejaculation in younger patients produce an inflammatory reaction that can develop into an abscess. Prompt urinary diversion and antibiotic therapy decrease the likelihood of infection sequelae, such as urethrocutaneous fistulae, periurethral diverticulae and, rarely, necrotising fasciitis.

Following adequate healing of associated injuries and stabilization of urethral injury, the urethra can be thoroughly re-evaluated radiographically and any reconstruction planned.

Blunt anterior urethral injuries are associated with spongiosal contusion making it more difficult to evaluate urethral debridement in the acute phase. Acute or early urethroplasty is therefore not indicated and suprapubic diversion is the best management.

Satisfactory urethral luminal recanalization occurs in approximately 50% of partial anterior urethral disruptions [19,21]. Short and flimsy strictures are managed with optical urethrotomy or urethral dilatation. Denser strictures require formal urethral reconstruction. The choice of surgical repair techniques (anastomotic vs patch) are guided by a combination of length of injury, location, tissue extendability, degree of tissue mobilization and tissue quality. As a general rule, anastomotic urethroplasty is indicated in strictures <1 cm long of the penile urethra and in strictures <2 cm long of the bulbar urethra.

To avoid chordee, longer strictures of the anterior urethra should not be repaired by an end-to-end anastomosis, and augmentation urethroplasty is generally indicated. Almost all complete ruptures of the anterior urethra require anastomotic or patch urethroplasty at 3–6 mo. The only exception is urethral injury associated with penile fracture, which usually results in partial urethral disruption and can be repaired at the time of cavernosal closure (level of evidence: 4).

4.2.2. Open injuries of the penile urethra

Male urethral injuries: stab wounds, gunshot wounds and dog bites to the urethra often involve the penis and testes and require immediate exploration. During surgery, the urethral injury can be surgically evaluated and repaired.

Urethral strictures form in fewer than 15% of these patients [22] (level of evidence: 4).

Primary urethral suturing involves direct visualization of the severed urethral ends and creation of a watertight, tension-free repair. A circumferential subcoronal incision should be used to deglove the penis. A perineal incision may be necessary in some patients to allow mobilization of the bulbar urethra.

In complete disruption, the corpus spongiosum is mobilized at the level of the injury and the urethral ends dissected distally and proximally. Urethral ends are spatulated and end-to-end anastomosis is fashioned over a 14–18 Fr Foley catheter. Small lacerations should be sutured with fine absorbable material. Subsequent formation of fistulae can be prevented by careful overclosure of the corpus spongiosum and skin [3]. Urethral debridement can be kept to a minimum because the spongiosum is well vascularized and heals well.

As with any surgery, preoperative antimicrobial prophylaxis are essential, though there is no evidence that postoperative antibiotic prophylaxis is effective. After 10–14 d, a pericatheter retrograde urethrogram or a voiding urethrography should be performed. The catheter should be removed if there is no leakage at the anastomotic site. The catheter should be left in if there is leakage and the cystourethrogram should be repeated after 1 wk.

Primary repair should be aborted if primary anastomosis is not possible because of extensive disruption of the urethra, i.e. defects >1–1.5 cm long. Instead, the urethra should be marsupialized in preparation for a two-stage urethral repair, and a suprapubic urinary diversion should be considered. A delayed elective procedure should be carried out at a minimum of 3 mo after injury. There is no role for acute placement of a graft or flap in the initial management of any urethral injury as contamination or decreased blood supply can compromise the repair [11] (level of evidence: 4).

4.3. Posterior urethral injuries

It is important to differentiate between inflammatory or iatrogenic posterior urethral strictures and true pelvic fracture urethral distraction defects because they require entirely different surgical approaches. The term urethral stricture should be used to indicate a narrowing of the urethral continuity, such as sphincter strictures due to instrumentation or partial urethral tears. Urethral distraction defects have a gap between the two retracted and injured ends of the urethra, which is filled initially by the pelvic haematoma and later by fibrotic tissue.

Erectile dysfunction occurs in 20–60% of patients after traumatic posterior urethral rupture [23–27]. The most important determining factor associated with impotence is severity of the initial injury. Spontaneous return of potency may occur up to 2 yr after injury [14]. Gibson reported an incidence of improved sexual function after 18 mo in 21% of patients [24] (level of evidence: 4).

4.3.1. Partial urethral rupture

Partial tears of the posterior urethra should be managed with a suprapubic or urethral catheter. Urethrography should be performed at 2-wk intervals until healing has occurred [8,18]. Partial tears may heal without significant scarring or obstruction if managed by diversion alone [20,28]. Residual or subsequent stricture should be managed with urethral dilatation or optical urethrotomy if short and flimsy, and with anastomotic urethroplasty if dense or long [7,18] (level of evidence: 4).

4.3.2. Complete urethral rupture

Complete ruptures of the posterior urethra should be managed with a suprapubic catheter. There is still controversy between those supporting early intervention to realign the urethra and drain the pelvic haematoma and those supporting initial suprapubic cystostomy alone with delayed repair of the ensuing urethral defect.

Acute treatment options include:

- Primary endoscopic realignment; usually performed during the first 10 d after the injury.
- Immediate open urethroplasty; however, this is experimental and therefore not indicated.

Delayed treatment options include:

- Delayed primary urethroplasty (surgery performed during the first admission, usually within the first 2 wk), which implies primary repair 1–2 wk after injury and is mainly used in female urethral trauma. There is a lack of supporting evidence for its use in male patients in whom it should not be performed [29].
- Delayed formal urethroplasty (surgery deferred until coexisting orthopaedic injuries have healed) at, or later, than 3 mo after injury, which is the most commonly used approach. It is the procedure of choice and the gold standard for treating posterior urethral distraction defects (level of evidence: 3).
- Delayed endoscopic incision of the scar tissue between the urethral ends, i.e. 'cut-to-the-light' or similar procedure. This procedure has a high failure rate and is rarely indicated (level of evidence: 4).

4.3.2.1. Primary realignment. The management of complete posterior rupture of the urethra has changed in recent years. Early urethral repair has become an option because orthopaedic management of pelvic fractures now includes immediate external and internal fixation [18].

If immediate exploration is not indicated, posterior urethral disruption can be managed in a delayed primary fashion. Primary realignment requires placement of a suprapubic tube at the time of initial injury, with realignment undertaken when the patient is stable. This usually takes place within 7 d when most patients are stable and most pelvic bleeding has resolved. Internal realignment aims to correct severe distraction injuries rather than prevent a stricture.

It is important to avoid damage to the bladder neck during endoscopic manoeuvres because in many patients it is the only remaining functional sphincteric mechanism. Only about 30% of patients do not develop urethral stricture after catheter withdrawal. These strictures are felt by some authors to be more easily managed at the time of delayed formal urethroplasty [30,31] (level of evidence: 3).

Open urethral realignment by simply passing a catheter across the defect, without trying suture anastomosis, should only be performed in patients undergoing open abdominal or pelvic surgery for associated injuries or internal bone fixation or in cases of concomitant bladder neck or rectal injury. Haematomas preventing adequate pelvic descent can be evacuated at the same time [29,32].

Concomitant bladder neck or rectal injuries should be repaired immediately and bone fragments removed off the injury sites to reduce the risk of incontinence and life-threatening infection [8,33–36]. The potential advantage of this type of management is not only to repair the bladder neck and/or rectal injury, but to reduce the incidence and severity of the urethral defect. Nevertheless, restricture is noted in 50–100% of patients (level of evidence: 3).

The decision to proceed with primary endoscopic realignment is greatly influenced by the patient's overall condition and extent of associated injuries. Most patients with pelvic crush injuries have multiple organ injuries. Associated lower extremity fractures can prevent placement in the lithotomy position, though flexible cytoscopy in the supine position is sometimes possible. Head injuries increase the adverse risks of anaesthesia. However, if these conditions can be controlled so that a haemodynamically stable patient can undergo a longer anaesthesia in the lithotomy position, endoscopic urethral realignment can be considered during the first 2 wk after trauma.

The benefits of primary endoscopic alignment are similar to those of primary open urethral realignment:

- There is a lower stricture rate than with suprapubic catheter placement alone (64% vs 100%) [37]. The need for a second operation for urethral reconstruction is avoided in about one-third of patients [38].
- If scarring occurs, it is simpler to restore urethral continuity using endoscopic procedures or dilatation.
- If urethroplasty is required, it is technically easier when the prostate and urethra are well aligned; the disadvantage might be a higher incidence of erectile dysfunction and incontinence when compared with delayed reconstruction [37,39] (level of evidence: 3).

Endoscopic primary realignment fulfils these criteria and should be used when a primary procedure is contemplated. Due to its higher morbidity, open primary realignment in the absence of bladder neck injury or rectal injury should not be used to treat posterior urethral injuries.

The great variation of techniques used for primary realignment procedures confuses comparison with delayed repair procedures [40–43]. Immediate realignment has been associated with an impotence rate of about 35%, incontinence rate of 5% and restricture rate of 60%.

Primary realignment techniques described in the literature include [41–44,29,45]:

- simple passage of a catheter across the defect
- catheter realignment using flexible/rigid endoscopes and biplanar fluoroscopy
- use of interlocking sounds ('railroading') or magnetic catheters to place the catheter
- catheter traction or perineal traction sutures to pull the prostate back to its normal location
- pelvic haematoma evacuation and dissection of the prostatic apex (without suture anastomosis) over a catheter. Open realignment techniques that include suture anastomosis between the prostatic apex and the membranous urethra should be considered a form of immediate open urethroplasty.

Realignment may not join the margins of the severed urethra completely. Traction on the catheter might not improve healing of the urethra and may harm continence [34,38]. Favourable results have been reported with immediate urethral realignment with minimal traction without suture repair bolsters [31,40,42,44,46–60] (level of evidence: 4).

4.3.2.2. Immediate open urethroplasty. Immediate open urethroplasty of posterior injuries is not indicated due to poor visualization and an inability to assess urethral disruption during the acute phase because of extensive swelling and ecchymosis. Incontinence (21%) and impotence (56%) rates are higher than with other techniques described in these guidelines [8,20,30,35,37,61,62] (level of evidence: 4).

However, in posterior urethral injuries associated with concomitant bladder neck or rectal injuries, immediate open exploration, repair and urethral realignment over a catheter is advisable [8,33–36]. In children, concomitant bladder neck and prostatic urethral injury is more common than in adults and more cases of immediate open urethroplasty are reported [1] (level of evidence: 4).

4.3.2.3. Delayed primary urethroplasty. Delayed primary urethroplasty (surgery performed during the first admission, usually within the first 2 wk), is mainly used in female urethral disruption. A suprapubic tube is placed at the time of initial injury. Repair is undertaken when the patient is stable, usually within 7 d. Fewer than 50 cases (mostly case reports) have been published [17] (level of evidence: 4).

Delayed primary repair tries to preserve as much urethral length as possible, and to prevent the urethra becoming embedded in dense scar tissue with consequent incontinence. Surgical exploration should be attempted via the retropubic route for proximal injuries and the vaginal route for distal injuries [8] (level of evidence: 4).

4.3.2.4. Delayed urethroplasty. Delayed urethroplasty (surgery deferred until coexisting orthopaedic injuries have healed, usually after 3 mo) is the procedure of choice and the gold standard for treating posterior urethral distraction defects in males. It should be performed in a referral centre to

Table 3 – Circumstances that might preclude successful perineal anastomotic repair as either initial or salvage therapy [65,66]

Circumstance	Alternative procedure
Distraction defects longer than 7–8 cm	A tubed interposition flap of penile or peri-neoscrotal skin can be used for reconstruction. However, this is seldom required. Most patients that require the use of flap urethroplasties have previous failed repairs of posterior urethral rupture. Salvage stage procedures may be sometimes necessary
Fistulae	These may require a combined abdominoperineal approach to secure adequate closure
Synchronous anterior strictures	The presence of anterior urethral stricture may compromise the blood supply to the bulbar urethra following division of the bulbar arteries. These patients should be treated cautiously
Urinary incontinence	The distal urethral sphincter mechanism could be defunctionalized by urethral distraction, so urinary continence may be maintained primarily by the proximal bladder neck sphincter. Concomitant bladder neck injury might increase incontinence, and could require an abdominoperineal procedure to allow simultaneous bladder neck and urethral reconstruction. The most common cause of bladder neck incompetence is circumferential tethering of the uninjured bladder neck by scarring. In such cases, it is usually possible to restore functional competence of the bladder neck by mobilizing it meticulously. This can be accomplished by removing the dense haematoma-fibrosis anchoring the bladder neck to the pubis, anteriorly and laterally. Secondary rescarring is prevented by placement of a local omental flap

optimize the results. The delay in treatment allows for healing of associated injuries, damaged skin and tissues and pelvic haematoma. The only drawback is the length of time of suprapubic catheterization before treatment [63]. In patients managed by initial suprapubic cystostomy, elective urethroplasty is recommended 3–6 mo after injury. This allows ample time for absorption of the pelvic haematoma and descent of the bladder and prostate to a more anatomical position. Standard evaluation before urethroplasty includes urine culture, plain x-ray of the pelvis to visualize the degree of distortion of the bone pelvic anatomy and detect any bladder stones, cystography, retrograde urethrography and combined cysto-urethrography with a straining film to determine the urethral distraction defect and the degree of bladder neck function. In some patients, endoscopy is necessary. This is either antegrade to evaluate the bladder neck condition and to detect the presence or absence of bladder stones, or retrograde to evaluate the condition of the anterior urethra.

Most posterior urethral distraction defects are short and usually resolved by a perineal approach anastomotic repair. However, a 'perineal progressive approach' is required when the prostatobulbar gap is longer than 2–3 cm due to a high dislocation of the prostate or when the mobilized urethra is too short because of damage during a previous surgical procedure. The progressive approach involves a series of manoeuvres to produce sufficient anterior urethral mobility to bridge up to 8 cm of separation [64] (level of evidence: 4).

The progressive perineal approach has also been used as a salvage procedure following failed repair.

There are various circumstances that may preclude successful perineal anastomotic repair as either initial or salvage therapy. These circumstances probably represent fewer than 5% of cases and are shown in Table 3 [65,66].

4.3.2.5. Comparison of different techniques. Koraitim [36] reviewed different techniques used in a personal series of 100 patients combined with a review of 771 patients from published reports.

Immediate and early realignment (n = 326) was associated with rates of 53% for stricture, 5% for incontinence, and 36% for impotence. Of the patients successfully managed with immediate realignment, 42% needed subsequent instrumentation to attempt stabilization of stricture. Urethroplasty was ultimately necessary in 33%.

Primary suturing (n = 37) was associated with rates of 49% for stricture, 21% for incontinence, and 56% for impotence. In comparison, inserting a suprapubic catheter before delayed repair (n = 508) was associated with rates of 97% for stricture, 4% for incontinence, and 19% for impotence.

The restricture rate after delayed anastomotic urethroplasty was less than 10% [1,23,27,67–72]. The risk of impotence caused by delayed urethroplasty was about 5% [18,23,27,35,73–76].

The gold standard therefore remains delayed urethral repair at a minimum of 3 mo after trauma, using a one-stage perineal approach (level of evidence: 3).

The results in children appear to be similar to those in adults. The higher incidence of abdominal surgery in children is due to an increased risk of bladder neck damage [76,77].

4.3.2.6. Reconstruction of failed repair of posterior urethral rupture. - Restenosis after delayed urethral repair usually occurs within 6 mo. The principles of salvage repair are similar to those of the initial procedure.

Progressive perineal anastomotic repair alone is successful in 85% of salvage urethroplasties. If anastomotic repair is impossible, other options include:

- one-stage substitution urethroplasty
- two-stage repairs with either scrotal inlays, smesh split-thickness skin grafts or buccal mucosal grafts [32,78–80].

However, data about the outcome of these procedures are scarce. In some patients with recalcitrant strictures, self-intermittent catheterization is another valid option (level of evidence: 4).

The main indications for a combined abdominoperineal surgical approach are:

- presence of fistulous tracts to the bladder base, abdominal wall or rectum
- periurethral epithelialized cavities
- inability to achieve the lithotomy position [66].

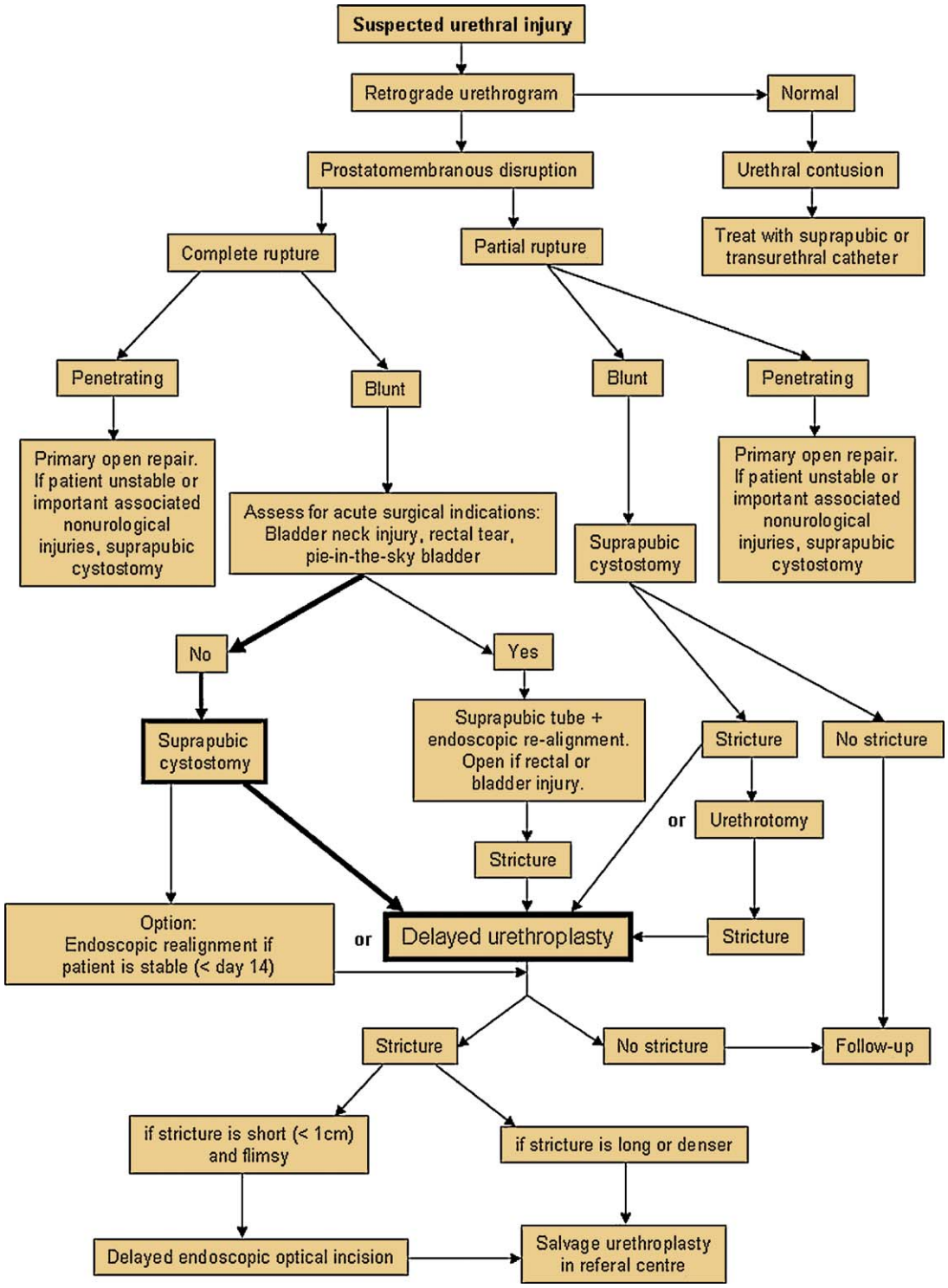

Fig. 1 – Management of posterior urethral injuries in men. ('Pie-in-the-sky' bladder is referred to as a high-riding bladder, which means that the bladder is severely displaced cranially by a pelvic haematoma).

Restenosis of the urethral lumen to 12 Fr or less is necessary before a significant reduction in flow is apparent [81]. A wide-calibre stricture may be observed or gently dilated. Optical urethrotomy is an alternative, particularly for a short, narrow stricture.

4.3.2.7. Delayed endoscopic optical incision. This procedure has a high failure rate and is rarely indicated. The principles of the procedure were described by Sachse in 1974 [81]. A curved metal sound is passed through the suprapubic cystostomy into the blind-ended proximal urethra. A direct vision

urethrotome is inserted into the urethra, and cuts are made towards the sound. Modification of this technique involves using an electrode to 'cut towards the light' [82] and the use of laser energy [83].

The procedure is only indicated in patients with very short urethral defects, competent bladder neck and minimal displacement of the prostate and proximal bulbous urethra [84]. Although immediate restoration of urethral continuity is commonly possible, failure often occurs (level of evidence: 4).

Urethral dilatation, optical urethrotomy and transurethral resection of stricture will be needed in about 80% of patients. Most repeat urethrotomies are performed in the first year of follow-up.

Once a urethrotomy has failed, alternative treatment is needed because a repeat urethrotomy will provide only temporary relief [85]. Urethral false passage and rectal perforation have been reported [84,86,87]. Stents are not currently recommended for patients with strictures following pelvic trauma because of the risk of fibrotic tissue invading the lumen of the stent [68,88–90].

5. Recommendations for treatment of posterior and anterior urethral injuries

The optimal management of patients with prostatomembranous disruptions is not simply a matter of delayed repair versus other types of treatment. Each patient should be assessed and managed according to the initial clinical circumstances. Figs. 1–3 provide algorithms for the treatment of urethral injuries.

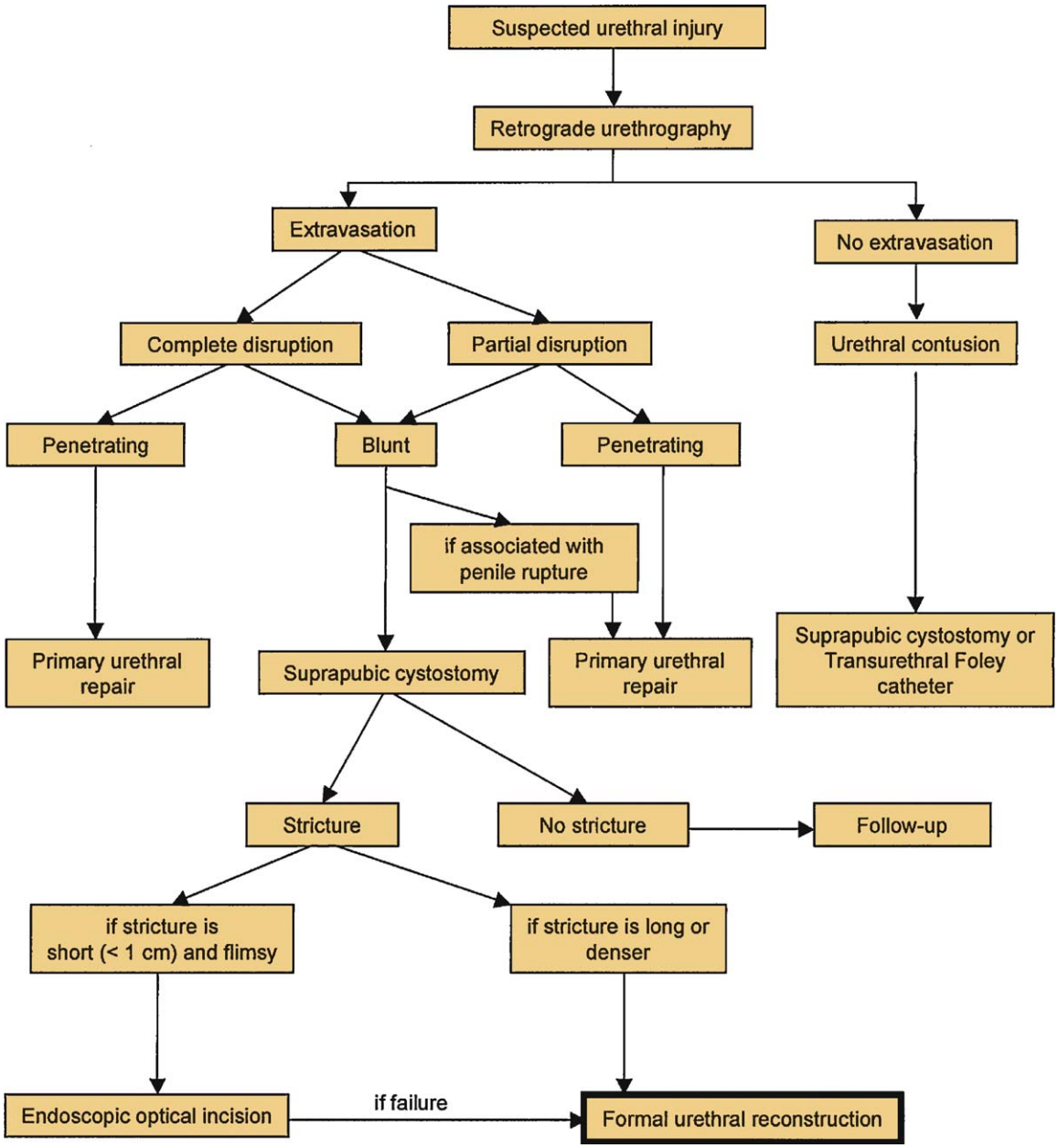

Fig. 2 – Management of anterior urethral injuries in men.

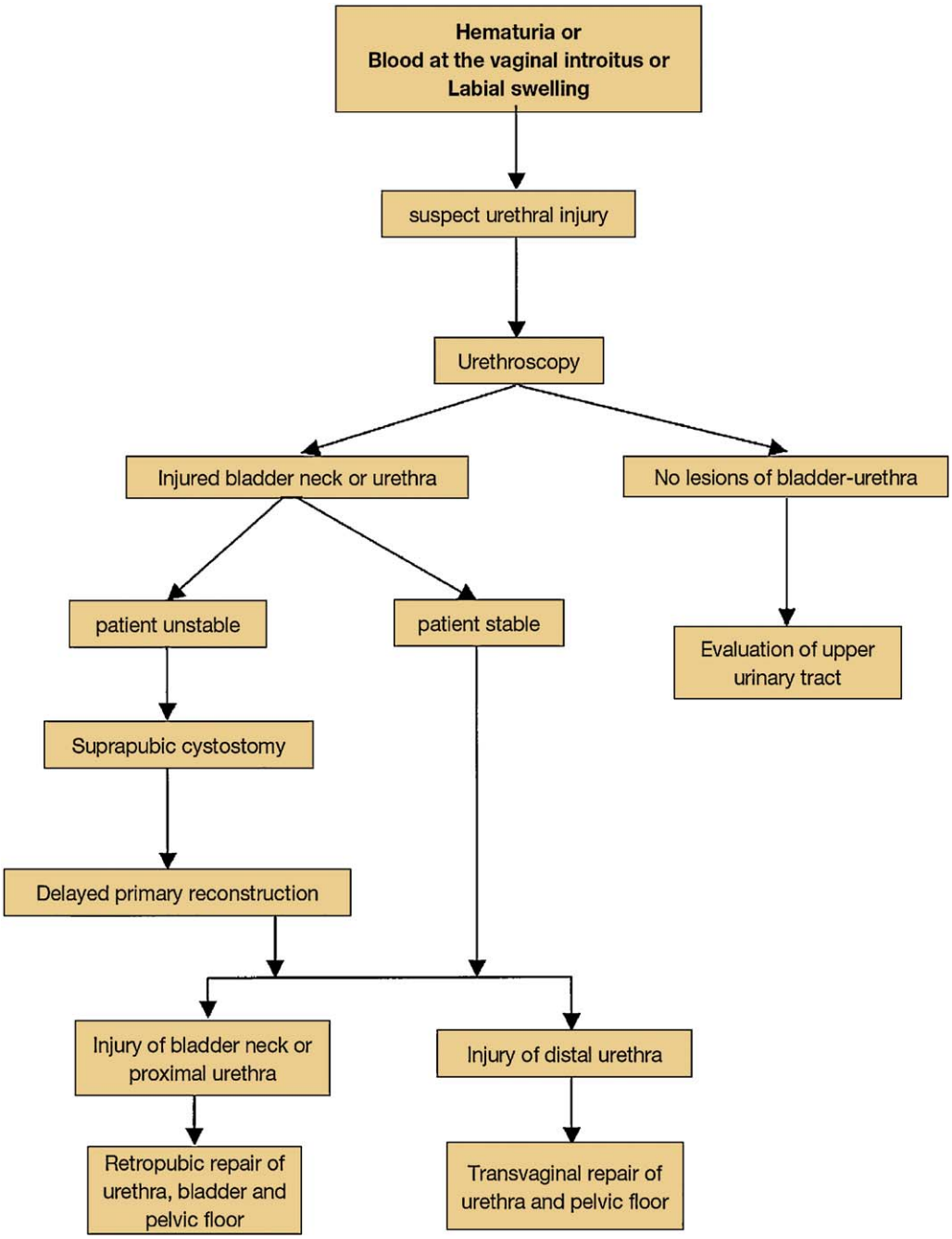

Fig. 3 – Management of urethral injuries in women.

6. Iatrogenic urethral trauma

Iatrogenic urethral trauma is by far the most common cause of urethral trauma and is usually due to instrumentation. It usually results in strictures of varying location and severity and often requires different management strategies [91,92].

Many iatrogenic lesions are caused by improper or prolonged catheterization [93] and comprise 32% of urethral strictures [92] (level of evidence: 3). The estimated risk of urethral injury due to improper catheterization during a hospital stay is 3.2 per 1000 [94]. Urethral catheterization should be avoided whenever possible in males with previous surgery for hypospadias because of the higher risk of inducing urethral strictures, although there is no publication supporting this assumption. If performed, fine-calibre catheters should be used. Transurethral procedures, especially transurethral resection of the prostate (TUR-P), are another common cause of iatrogenic urethral lesions. The anterior urethra is primarily affected, while the bladder neck is rarely affected by prolonged catheterization [93] (level of evidence: 1b).

Sphincteric damage with concomitant incontinence and stricture formation is possible.

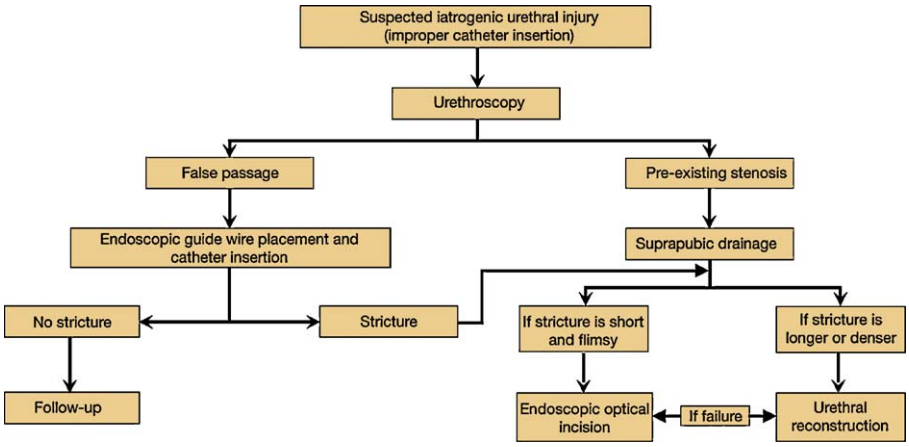

Fig. 4 – Flow diagram of treatment for iatrogenic urethral injury caused by improper insertion of a catheter.

In one study of patients treated with TUR-P, strictures were more likely with postoperative silicone Foley catheters than with latex catheters [95] (level of evidence: 1b).

The incidence of iatrogenic urethral trauma following surgical treatment of prostate cancer ranges from 1.1–8.4%, depending on the treatment used. The risk is highest after radical prostatectomy or brachytherapy plus external beam radiotherapy [96]. New surgical methods, such as robot-assisted prostatectomy, can also cause iatrogenic trauma, probably at a similar rate (2%) as conventional radical prostatectomy [97].

Iatrogenic injuries to the urethra can occur after abdominal and pelvic procedures. Pre-procedure bladder catheterization must be performed to prevent or to reveal these complications [98] (level of evidence: 2).

6.1. *Diagnosis of iatrogenic urethral injury*

The symptoms of urethral injury caused by improper catheterization or use of instruments are penile and/or perineal pain (100%) and urethral bleeding (86%) [94] (level of evidence: 2b).

6.2. *Management*

Temporary urethral stenting with an indwelling catheter is a good conventional therapeutic option for treating acute false passage [99]. If placement of a urethral catheter is impossible, endoscopic assistance or placement of a suprapubic tube may be necessary [100] (level of evidence: 3).

Iatrogenic anastomotic strictures after radical prostatectomy can be successfully treated by endoscopic management, either by incision or resection. Repeat therapy may be necessary. Placement of urethral stents at the bladder neck together with the placement of an artificial sphincter has also been reported as a valid option in recurring strictures, but should be performed only in selected patients [101,102]. The alternatives are a permanent indwelling catheter, urethral dilatation, intermittent self-catheterization, or open procedures. Open procedures fashioning a new vesicourethral anastomosis carry increased morbidity and are also associated with the placement of an artificial sphincter [103] (level of evidence: 2b). Long-term results about the outcome of all these procedures are scarce. Alternative procedures in recalcitrant cases and in post-TUR-P double sphincteric lesions (incontinence + stricture) are procedures that abandon the urethral outlet, such as

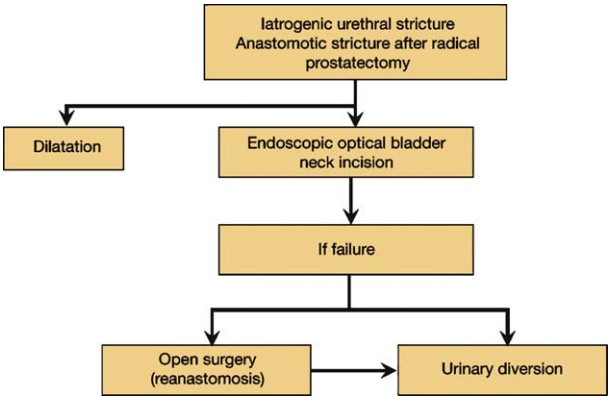

Fig. 5 – Flow diagram of treatment for stricture after radical prostatectomy.

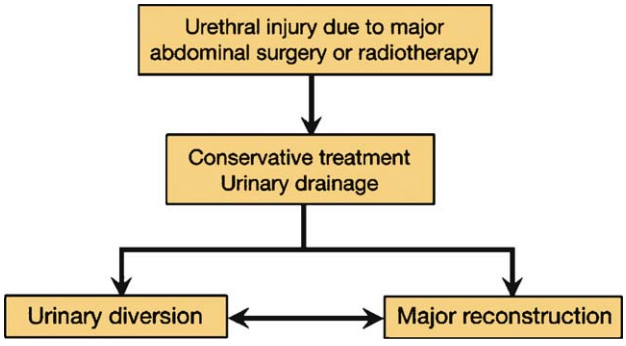

Fig. 6 – Flow diagram for treatment for stricture after major abdominal surgery or radiotherapy.

urinary diversions, continent vesicostomy or permanent suprapubic catheter [104,105] (level of evidence: 3).

Figs. 4–6 provide algorithms for the treatment of stricture after urethral injury due to improper insertion of a catheter, radical prostatectomy, and major abdominal surgery or radiotherapy, respectively.

6.3. Recommendations for avoiding iatrogenic urethral trauma

- Avoid traumatic catheterization.
- Keep the length of time an indwelling catheter is present to a minimum.
- Major abdominal and pelvic surgery should be undertaken with a urethral catheter as a guide and protective structure.

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