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The standard for the management of male urethral strictures in the UK: a consensus document

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Abstract

Objective: The aim of this study was to establish an evidence-based best clinical practice consensus for the management of urethral stricture disease in the UK.

Methods: A systematic review of optimal management of urethral stricture generated a base document which was endorsed by the British Association of Urological Surgeons (BAUS) section of Andrology and Genito-Urinary Reconstructive Surgeons (AGUS). A two-round electronic mail modified Delphi survey of 43 consultant reconstructive urologists, members of the British Association of Genito-Urinary Reconstructive Surgeons (BAGURS), was then performed. The panel's views about the base document was sought in seven domains: definition, diagnosis, investigation, conservative, endoscopic and reconstructive treatments, and follow up. Responses were collated and used to modify the base to achieve a consensus statement.

Results: In round one of the Delphi process four panel members commented on the base document and seven in round two. Consensus was thereby reached on 38 statements regarding definition (one), diagnosis (three), investigation (two), conservative/endoscopic (five) and reconstructive (24) treatments and follow up (three) for the management of urethral stricture disease.

Conclusion: This consensus statement will help standardise care, provide guidance on the management of urethral stricture disease, and assist in clinical decision-making for healthcare professionals of all grades.

Keywords

Urethra, stricture, urethroplasty, consensus statement, UK practice, Delphi process

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Introduction

Urethral strictures result from circumferential scar formation in the epithelium and underlying corpus spongiosum of the urethra, to varying degrees, causing progressive narrowing of the urethral lumen. This results in lower urinary tract symptoms, most commonly a reduction in urinary stream.[1] Left untreated, strictures can lead to serious complications such as recurrent urinary tract infections, urinary retention and eventual renal impairment.

Urethral stricture disease is a relatively common occurrence with a published prevalence in the USA between 0.6 and 0.9%.[2,3] Prevalence increases with age, rising from around 20/100,000 at age 55 years to over 100/100,000 for men aged over 65.[4] In the UK urethral stricture disease

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(Primary Diagnosis: 3 character – OPCS code N35) was responsible for just over 17,000 UK National Health Service (NHS) hospital admissions in 2016–2017.[5] Management of urethral strictures by urethroplasty, urethral dilatation and urethrotomy cost the NHS just under £18 million in the 12-month period between April 2016 and March 2017.[6]

A commissioning guidance document for the management of anterior and posterior urethral strictures in the UK is long overdue. Its principal aim should be to help advise general urologists, who usually make the initial diagnosis of urethral strictures and may embark on various and repeated endoscopic interventions as treatment, and are involved in the acute management of patients sustaining urethral trauma as a consequence of pelvic fracture. It should advise about perceived best practice in these areas and lay down important recommendations as to when and where patients with urethral stricture disease should be referred for definitive reconstructive surgery. It should also provide specialist reconstructive surgeons with guidance of the choice of surgical techniques for the different types of anterior and posterior urethral stricture based on stricture aetiology, location, length and previous treatment history.

An evidence-based consensus document (the base document) was written by co-opted members of the British Association of Genito-Urinary Reconstructive Surgeons (BAGURS) for the section of Andrology and Genito-Urinary Reconstructive Surgeons (AGUS) of the British Association of Urological Surgeons (BAUS).

Materials and methods

The base document was developed from evidence provided from the BAUS Clinical Outcomes Publication (COP) data,[1] with reference to the American Urological Association male urethral stricture guideline,[7] the various Société Internationale d'Urologie/International Consultation on Urologic Diseases (SIU/ICUD) consultations on urethral strictures[8–14] and an extensive literature review. This sought to amalgamate best-practice evidence regarding the management of anterior (penile and bulbar strictures) urethral strictures and pelvic fracture-related injuries to the bulbomembranous urethra; this original document was tailored, as much as possible, to the requirements of clinicians practising within the UK NHS, but did not cover the management of prostatic urethral stenosis, bladder neck contracture or urethral fistula surgery.

Agreement of the principals of the document were endorsed by AGUS and this was then circulated by email to 43 consultant members of BAGURS on two occasions during the autumn of 2019 employing a modified Delphi process.[15] This panel were thought to represent the best repository of knowledge about all facets of the management of urethral stricture disease in the UK; a Delphi process allowed further clarification of matters of debate and to present arguments to justify viewpoints so that a consensus could be agreed between the panel and the authors.

The views, specifically, about the optimal management of urethral strictures across seven domains in one confluent document were sought from the panel: the definition of stricture disease and its diagnosis; appropriate investigations; the conservative, endoscopic and reconstructive treatments available and their application; and follow up after appropriate management. Responses were collated by two of the authors and used to modify the base document.

Results

During the Delphi process four extensive comments were made encompassing 32 minor stylistic or typographic issues and 18 regarding factual or knowledge-based concerns, in the first round. Seven minor or stylistic issues were made in the second round. These issues were all addressed to derive the final consensus statement below.

1.0 Terminology

1.1 The term 'stricture' should be reserved for narrowing of the lumen of the anterior urethra, namely the penile and bulbar urethra, caused by scarring and fibrosis within the surrounding corpus spongiosum.

Narrowing of the prostatic urethra (such as following radiotherapy, or thermal energies for prostate cancer, or following transurethral surgery) should be referred to as prostatic 'stenosis'. Similarly, a constriction of the membranous urethra which is not due to a pelvic fracture urethral injury should be called a stenosis, albeit accepting the widespread use of the term 'sphincter stricture'. Narrowing at the anastomotic site following radical prostatectomy should be referred to as an anastomotic 'contracture'.

1.2 Urethral stricture should form part of the differential diagnosis in all men with lower urinary tract symptoms (LUTS) particularly a reduced urinary stream, recurrent urinary tract infection and incomplete voiding.

Men who are more likely to have a diagnosis of stricture include younger men presenting with LUTS, those with a history of previous hypospadias surgery, in the presence of lichen sclerosus (LS), or having had previous urethral catheterisation, transurethral surgery, pelvic irradiation or fall-astride injuries.

2.0 The diagnosis of urethral stricture disease

2.1 A diagnosis of urethral stricture is made after clinical evaluation, supplemented by Patient Reported Outcome Measures (PROMS), to determine symptoms, severity and bother.

2.1.1 The initial documentation of the man with urethral stricture disease should include information about the aetiology of his stricture, his symptoms, an initial flow rate and post-void ultrasound residual and urinalysis. A PROM[16,17] and an assessment of the patient's sexual function, such as the sexual health inventory for men (SHIM) IIEF 5,[18] should be undertaken before contemplating surgery.

2.1.2 Uroflowmetry should be performed as this objectively demonstrates the severity of restriction to urinary flow. It can also point to a diagnosis of stricture if a typical 'flat-topped' prolonged trace, with a low maximal flow rate, is demonstrated.[19]

2.1.3 The presence of a stricture is confirmed either by urethrography or endoscopically. A full, lateral, retrograde urethrogram is essential to determine the location, length and number of strictures as well as the degree of luminal narrowing. An antegrade, or voiding, study is necessary to demonstrate the proximal extent of the stricture as well as obstruction to flow inferred by the presence of pre-stenotic dilatation. Urethroscopy, besides being more invasive, only determines the presence of a stricture by visualisation of its distal extent. Expert opinion, therefore, advises the preferential use of urethrography over endoscopy to complete the investigation of a man with a suspected urethral stricture. Ultrasound urethrography is an alternative to conventional fluoroscopy; the added advantage of being able to measure the extents of spongiosal fibrosis may help in the choice of urethroplasty technique.[20]

3.0 Treatment of urethral stricture disease

3.1 The treatment of urethral strictures is either by endoscopic management or open surgical reconstruction – urethroplasty.

The choice of treatment should depend on factors including:

- length, location, aetiology and number of strictures;
- type, number and timing of previous interventions;[21]
- symptom severity and the presence of complications;
- patient factors including co-morbidities and patient preference;
- the expertise available.

3.2.0 Conservative and endoscopic management

3.2.1 Surgeons may perform either Direct Visual Internal Urethrotomy (DVIU – stricture incised by hot or cold knife, or laser) or urethral dilatation (UD – stricture radially stretched and thereby disrupted) when offering endoscopic intervention.

The method used to incise the stricture during DVIU (laser v. cold knife) does not influence the outcome.[22,23] The literature suggests there is also no difference in outcome between urethrotomy and dilatation; however there is only one randomised controlled trial comparing the two, dating back to 1997.[24] Most studies relate to urethrotomy alone, combine urethrotomy and dilatation and fail to separate the two, or don't include urethral dilatation. Different studies describe various methods for dilatation or urethrotomy and most have heterogenous cohorts for stricture location, aetiology and length. There is also lack of standardisation of outcome measures and follow-up is usually short.

There is no reliable comparative data on complications of these interventions; however, dilatation using serial dilators over a guidewire has been associated with a 2.5% overall complication rate,[25] significantly less than the 20% bleeding and 10% false passage risk reported with DVIU.[26] Consequently, expert opinion would recommend dilatation over a guidewire as the endoscopic treatment of choice for urethral strictures.

Both DIVU and UD should be performed with antibiotic cover.[27] There is limited evidence about how long a urethral catheter should remain after DIVU; what evidence exists suggests that this should be at least three days to reduce the risk of extravasation and infective complications.[28]

3.2.2 The use of adjunctive agents injected after urethrotomy cannot currently be currently recommended.

Agents such as Mitomycin C[29,30] and steroids[31] injected into the stricture site after urethrotomy has shown promise in some studies with short follow-up, but their routine use cannot be recommended currently. Larger better designed trials are needed to confirm their efficacy in reducing stricture recurrence.

3.2.3 Self-catheterisation may be considered after DIVU or UD in carefully selected cases.

Such cases may be those occurring in the elderly or unfit, if they have the necessary manual skills, when:

- the stricture is particularly long or complex and major surgery is the alternative;
- or as a temporising measure until urethroplasty can be performed more expeditiously for whatever reason.

A recent Cochrane Analysis has demonstrated a potential reduced risk of stricture recurrence in

those patients performing self-dilatation after endoscopic manipulation; however the quality of the evidence available in the literature is poor and therefore no concrete recommendations can be made about this.[32]

3.2.4 The best results from endoscopic management are to be expected in previously untreated bulbar strictures less than 1 cm long.

Even though the curative rates after endoscopic intervention are generally poor, and patients very often need to come back for repeated intervention, superior results from endoscopic management may be expected in previously untreated bulbar strictures less than 1 cm long.[33,34] Nevertheless, it remains clear that the success rate decreases with time and repeated intervention, with only 7.9% stricture-free after the second intervention and virtually zero success after three or more endoscopic procedures.[35]

3.2.5 Urethroplasty has been shown to be more cost-effective than repeated endoscopic intervention for recurrent bulbar strictures.

In general, urethroplasty has been shown to be more cost-effective than repeated endoscopic intervention for recurrent bulbar strictures.[36,37] This concept has recently been challenged by the OPEN trial, the first randomised controlled trial comparing endoscopic intervention with urethroplasty for recurrent bulbar urethral strictures.[38] This trial has shown both interventions have comparable short-term outcomes, in terms of symptom control, however as expected, patients undergoing urethroplasty had a lower re-intervention rate over two years (16 v. 28%). These rates of re-intervention over the short period of follow-up in this trial, and the relatively high cost of urethroplasty meant that, at least in the UK, urethroplasty had only a 14% chance of being cost-effective for the treatment of recurrent bulbar strictures by comparison with DVIU.

3.3.0 Reconstructive surgery

3.3.1 Urethroplasty is the gold standard 'curative' treatment option for patients with urethral strictures.

Selected patients can be managed by endoscopic measures (see 3.2.4 above). However, given the high recurrence rate associated with these treatment modalities,[39] the risk of causing longer strictures with repeated intervention making subsequent urethroplasty more difficult,[40] and the negative impact on the quality of life associated with self-dilatation,[41] patients should be counselled in favour of urethroplasty early on in their care pathway unless there is a good reason not to.

3.3.2 Patients with urethral strictures should be referred to high volume specialist referral centres for urethroplasty.

No two strictures are the same and one urethroplasty technique is not effective for all strictures, even if these are located within the same segment of the urethra. A surgeon performing urethroplasty must possess a broad repertoire of techniques to deal with all strictures that may be encountered, the choice of technique only being possible after careful intra-operative evaluation. Moreover, better urethroplasty outcomes are reported in the hands of high volume, more experienced surgeons.[42]

3.4.0 Bulbar urethroplasty – anastomotic urethroplasty

3.4.1 During urethroplasty for bulbar strictures resulting from trauma, usually fall-astride injuries, the stricture must be excised.

In these post-traumatic strictures, spongiofibrosis usually involves the entire thickness of the urethral wall with no remaining vascularised spongiosal tissue.[43] This spongiofibrosis must be excised to healthy, well vascularised tissue on either side so that healthy edges can be spatulated and anastomosed in a tension-free fashion (Excision and Primary Anastomosis, EPA).[44] Traditionally, strictures shorter than 1–2 cm are considered to be amenable to EPA due to concerns regarding tension on the anastomosis leading to increased stricture recurrence, penile shortening and curvature during erection if longer segments are excised. However, urethral elasticity and length, and the degree of urethral mobilisation possible is highly variable. Consequently, recent reports have shown successful EPA for proximal bulbar strictures up to 5 cm long.[45] When EPA is not possible for longer strictures requiring excision but where a spatulated anastomosis cannot be formed, an augmented anastomotic technique, in which the ventral spongiosum is anastomosed in an end-to-end fashion and the dorsal aspect augmented with a graft, should be performed.[46] EPA is associated with excellent success rates in the range 85–95%, sustained in the long-term.[47,48]

3.4.2 Short bulbar strictures which are not traumatic in origin do not need to be excised and can be cured using a transecting or non-transecting technique.

In non-traumatic bulbar strictures the degree of spongiofibrosis is often surprisingly small, limited to around 10% of the thickness of the urethral wall, with well-preserved healthy underlying corpus spongiosum present.[49] In short proximal non-traumatic bulbar strictures, it is possible to

Table 1. Advantages and disadvantages of oral mucosal grafts (OMG).

Advantages	Disadvantages
Hairless and accustomed to being wet	Limited availability in full length strictures or recurrence following urethroplasty
Good handling properties	Donor site pain, bleeding and infection
Relative ease of harvesting	Scarring on the bite line occasionally causing problems with chewing
Concealed donor site	Scar contracture resulting in limited mouth opening
Thick epithelium and thin lamina propria promoting early inosculation	Peri-oral numbness
Resistance to recurrence of lichen sclerosus	Potential injury to Stenson's duct during harvesting
Resistance to infection (hosts a variety of micro-organisms hence its minimal inflammatory response to organisms)	

either excise the strictured area in its entirety or the superficial spongiofibrosis leaving healthy underlying spongiosum and anastomose the mucosal edges without transecting the spongiosum. Total excision of the strictured area is called a transecting anastomotic bulbar urethroplasty (TABU or EPA, Section 3.4.1). When a dorsal stricturotomy is made, the spongiofibrosis excised without excision of the spongiosus, the mucosal edges anastomosed and the stricturotomy finally closed transversely in a tension-free fashion, this procedure is known as a non-transecting anastomotic bulbar urethroplasty (NTABU). It may be associated with an 83–97% subjective, or objective, clinical improvement.[50]
Very short, membrane-like, proximal bulbar strictures can be incised as part of an NTABU dorsal stricturotomy without spongiosal excision. The stricturotomy is then simply closed transversely in a 'Heineke-Mikulicz' stricturoplasty fashion.[51]

3.5.0 Bulbar urethroplasty – augmentation urethroplasty

3.5.1 Longer bulbar strictures which are not suitable for excision or non-transection should be managed using an augmentation technique *via* a dorsal or ventral approach.
A stricturotomy is performed and the calibre of the affected urethra augmented using a substitution material without excising the stricture.[52]

3.5.2 Oral mucosal graft (OMG) harvested as a full-thickness graft from the inner aspect of the cheek (buccal mucosal graft (BMG)) or from the underside of the tongue (lingual mucosal graft (LMG)) has become the material of choice for augmentation/substitution when skin-based grafts or flaps are not possible, or are contra-indicated.
The reasons for this and limitations associated with its use are summarised in Table 1. Lingual grafts are an excellent substitution material when buccal mucosa is insufficient because it has already been used or for the reconstruction of very long strictures.[53]

3.5.3 When possible, the donor site should be closed.
Studies have failed to show that primary closure of the donor site improves long-term outcome,[54] however, opinion also suggests that whilst closure improves haemostasis it may worsen immediate post-operative pain. As more urethroplasty is moving towards day case surgery, better haemostasis may assume a particular relevance to aid early discharge but at the cost of more post-operative pain.

3.5.4 Tubularised substitution, using grafts or flaps, in a single stage should be avoided in urethroplasty.
Long strictures in which the lumen is completely obliterated, or the residual urethral plate too narrow for a successful augmentation, have been historically managed by excision and replacement by a graft or flap rolled into a tube over a catheter in a single stage. These have been associated with suboptimal outcomes and are no longer recommended.[55] One-stage tubularisation should be avoided in favour of a staged procedure or a combination of dorsal and ventral flaps and/or grafts.[56]

3.5.5 Hair-bearing skin should not be used in urethroplasty unless no other option exits.
Skin, particularly preputial, penile shaft or scrotal, was the commonest substitution material

prior to the popularisation of BMG. However, harvesting penile shaft skin may be associated with a poor cosmetic result at the donor site. Moreover, genital skin is often associated with ingrowth of hair resulting in stone formation, recurrent infections and reduction in the calibre of the reconstructed urethral lumen.

3.5.6 There still remains controversy as to whether grafts or flaps are best for urethral reconstruction.

A meta-analysis has shown equivalence in terms of functional outcome.[57] There are reports associating flaps with increased difficulty in raising them, more bruising and haematoma, as well as scarring and penile torsion when pedicled penile shaft skin flaps are used.

Definite recommendations however are:

Skin-based flaps should not be used in LS strictures because LS is a disease of genital skin. Buccal grafts are the treatment of choice.

Pedicled flaps with their own blood supply should be used preferentially to a free graft in situations where the graft bed is poor, as with severe scarring in redo surgery or following radiotherapy.

Several well-designed studies have demonstrated similar outcomes irrespective of whether the graft is positioned dorsally or ventrally or laterally.[58,59] Many claim that the ventral approach is easier because it requires less urethral mobilisation. It is suitable for mid and proximal bulbar strictures, particularly those very proximal strictures developing after transurethral resection of the prostate.[60] On the other hand the dorsal approach is suitable also for distal bulbar strictures and is felt to be a more versatile approach, providing the opportunity to perform stricturoplasty, non-transecting anastomosis and augmentation (depending on stricture characteristics) all through the same approach preserving the better vascularised ventral spongiosum.[61] Nevertheless, surgeons should use the approach that they are most familiar with and which gives the best results in their practice.

3.6.0 Bulbar urethroplasty – augmented non-transecting anastomotic urethroplasty

3.6.1 An augmented non-transecting approach may be used in long bulbar strictures in which there is a shorter near-obliterative segment.

Having performed a dorsal stricturotomy, a short obliterative segment may be excised in a non-transecting fashion and the urethral plate reconstituted by a mucosa-to-mucosal anastomosis. The rest of the stricturotomy is then augmented using a graft as in standard augmentation urethroplasty.[61] This technique prevents circumferential substitution of this narrowest segment which is inherently associated with inferior outcome. It also allows the use of narrower grafts which is important since most of these long strictures can be augmented using sublingual grafts (which are usually narrower than those harvested from the cheek).

3.7.0 Penile urethroplasty

3.7.1 Penile urethral strictures cannot be treated by excision and primary anastomosis. Penile urethroplasty must therefore involve augmentation or substitution techniques.

Unlike the bulbar urethra, which can be mobilised proximally and distally to allow excision of a stricture and a tension-free primary anastomosis, this is not possible in the penile urethra due to the risk of loss of length and curvature during erection.[62] Moreover, pendulous strictures usually tend to be longer[63] (in some series nearly twice as long) than in the bulbar urethra. This means that reconstructive techniques in the penile urethra are limited to augmentation or substitution using free grafts or flaps; these may also result in chordee if used incorrectly.

3.7.2 Penile urethroplasty may be staged or performed as a one stage procedure.

This depends on the extent of the diseased segment and the complexity of the problem and particularly on the availability of vascular supporting tissue (the glans spongiosum and the dartos fascia) to support a repair. This is because a tube graft does not 'take' predictably so must be avoided and a tube created by placing the graft flat on the graft bed at a first stage and then rolled into a tube at a second stage. This is however associated with graft failure and the need for revision prior to tubularisation in up to 30% of cases.[64] In order to avoid this, Joshi et al. have modified the technique and at the first stage simply marsupialise the stricture in a Johanson-type fashion.[65] The graft is inserted at the second stage after incision[66]/excision of the urethral plate and tubularisation is carried out at this stage. The authors report an 89.5% success rate at a median follow-up of 44 months.

3.8.0 Meatal and navicular fossa urethroplasty

3.8.1 The cosmetic outcome of surgery may be as important as the functional outcome, when contemplating surgery for strictures involving the meatus and fossa navicularis.

3.8.2 Meatal strictures can be dealt with by meatotomy or extended meatotomy with very good functional and aesthetic outcome, especially in non-obliterative strictures.[67]

3.8.3 Fossa navicularis strictures are more difficult to treat and stricture aetiology is especially

important in determining the urethroplasty technique chosen.

The two commonest defined aetiologies of navicular fossa strictures are LS and hypospadias.[1] In LS, skin-based substitution materials are not generally indicated as LS is a skin condition which has the potential to become involved by the disease process.[68]

Adults with hypospadias-related strictures have usually had previous reconstruction and the stricture re-occurs as a consequence of stenosis in the reconstructed skin tube. As there is a sparse, commonly non-existent spongiosum and a paucity of dartos, the previous repair usually needs to be excised completely and reconstructed from scratch, usually as a staged procedure.

3.8.4 The general principles of fossa stricture reconstruction must include excision of the spongiofibrosis, deepening of the glans cleft if necessary to create a meatus at the tip, use of a graft to recreate the glandular urethra and a layered tension-free closure to avoid formation of a urethro-cutaneous fistula.

This can be done as a staged procedure or as a single stage (the two-in-one staged approach) whereby the first and second stage procedure are performed at the same time. The factors which will determine whether this is possible or not are a good glans size and spongiosal thickness to be able to support a graft; adequate dartos with tissue mobility to allow tubularisation without tension on the suture line to avoid fistulation,[69,70] and the experience of the reconstructive surgeon.

3.8.5 Patients undergoing urethroplasty for navicular fossa and distal penile urethral strictures must always be consented for both a single or a staged procedure.

The decision as to which procedure to undertake can often only be made after careful intra-operative evaluation of the stricture and surrounding tissues.

3.8.6 Isolated strictures of the penile urethra (such as following instrumentation) which are not caused by LS are uncommon but are very well managed using a penile shaft skin flap.

A flap, as described by Orandi[71] and McAninch,[72] is raised on a dartos pedicle and rotated to be sutured as a ventral onlay to the edges of a ventral stricturotomy as a single stage procedure.

3.9 Urethroplasty for pan-urethral stricture disease

3.9.1 Pan-urethral strictures (involving multiple segments and sometimes the entire urethral length) may be managed by repeated endoscopic procedures with or without self-dilatation, urethroplasty or perineal urethrostomy.

Pan-urethral strictures are more difficult to treat as they invariably recur after endoscopic management.

Urethroplasty for pan-urethral strictures is a major undertaking, time consuming and must definitely be performed in supra-specialist referral centres in order to ensure the greatest possibility of success. The single stage technique popularised by Kulkarni which involves invagination of the penis through a perineal incision, one-sided lateral dissection of the urethra and quilting of the buccal graft dorsally is the preferred technique for these strictures.[73,74] This approach is also suitable for patients with penile strictures in whom the proximal extent is unclear or when there is a high possibility of a concomitant bulbar stricture. Both can be dealt with in this way through a single perineal incision.

Failure rates for pan-urethroplasty are higher than for single-segment urethral strictures. Consequently, it is perfectly reasonable, as an alternative, to offer these patients either clean intermittent self-catheterisation (CISC), a temporary or permanent perineal urethrostomy (see 3.9.2) or some form of urinary diversion, after having discussed their expectations of the outcome from urethroplasty with them.

3.9.2 Perineal urethrostomy is a feasible simple solution to a complex stricture problem in selected patients.

Indications include pan-urethral strictures, multiple failed urethroplasties, multiple comorbidities precluding complex long reconstructive procedures and patient choice. Perineal urethrostomy has been shown to be associated with a high quality of life compared with that associated with life-long stricture morbidity.[75] Men undergoing perineal urethrotomy need to be aware of the need to sit to void and that they will ejaculate through the perineal opening.

3.10.0 Urethroplasty for pelvic fracture-associated urethral stricture disease

3.10.1 The acute management of pelvic fracture urethral injuries should include one gentle attempt at urethral catheterisation and if not successful, immediate insertion of a suprapubic tube. Dealing with life-threatening non-urological injuries should be the priority in the acute phase.

Catheterisability is probably the single most commonly used diagnostic criterion for the presence or absence of a significant urethral injury. It is unlikely that such treatment will convert a partial into a complete injury or result in sepsis if done once and gently.[76] Both this and/or insertion of a suprapubic tube can be done quickly and

without diverting attention from the management of more serious injuries in polytrauma victims.

There is no concrete evidence that more aggressive techniques of bringing the two ends of the urethra together (primary realignment) by various endoscopic techniques, with and without fluoroscopic assistance, is associated with a superior outcome in the long term. Two large meta-analysis of more than 800 patients each have however shown that at least half the patients treated by early re-approximation develop strictures requiring further intervention.[77,78] Whether the rest remain stricture free in the long term is uncertain. Single-centre experiences also report recurrent stricture rates as high as 79%.[79]

Experimental evidence shows that partial urethral injuries may heal without stricture formation, whether or not they are stented with a catheter, while complete injuries will never heal without stricture unless the two ends are sutured together.[80] This means that primary realignment may be unnecessary in partial urethral ruptures and ineffective in complete injuries. Importantly, whereas supporters of primary re-approximation believe that even if strictures do occur after treatment, subsequent management including urethroplasty is easier,[81] there is now evidence to prove the contrary. At least two authors have reported significantly worse outcomes of urethroplasty in patients having undergone prior urethral manipulation compared with those managed by initial suprapubic drainage alone.[82,83]

3.10.2 Delayed urethroplasty should be the standard of care in patients with pelvic fracture urethral injuries.

This should be performed in a specialist supraregional centre three to six months after the injury by which time the patient has recovered fully, the pelvic haematoma has resolved, the prostate has descended to a more normal position and the scar tissue has stabilised. Stricture-free rates of up to 90–95% are achievable when these ideal conditions have been reached.[84,85] Bulbo-prostatic anastomotic urethroplasty should only be performed by a surgeon experienced in advanced urethral reconstruction techniques including corporal separation, wedge pubectomy and rerouting of the urethra behind the crura. Each of these techniques straightens out the course of the urethra, bridging the defect between the urethral ends and allowing for a tension-free anastomosis.

4.0 Follow up following urethroplasty

4.1 After urethroplasty, patients should be followed up in order to assess outcome (success or failure) and detect recurrent strictures at an early stage.

Follow-up of patients after urethroplasty should include documentation about their post-op symptoms, a further flow rate and post-void residual. A repeat PROM and SHIM should be undertaken to give some subjective patient evaluation of their outcome from intervention.

4.2 There is ongoing controversy as to which is the best modality for objective follow-up after urethroplasty. A combination of flow rate, ascending/descending urethrogram and ultrasound post-void residual will detect stricture recurrence in the majority of cases.[86,87] Endoscopic evaluation can be performed if doubt remains or if dilatation/urethrotomy are being considered.[88]

4.3 There is also no agreement about how long a patient should be followed up. The more practical approach is to discharge the patient with instructions to return if symptoms recur.

Conclusion

A consensus statement will help standardise the management of urethral stricture disease for UK-based patients and in the determination of a template for the commissioning of more complex reconstructive interventions.[89] This document provides a contemporary, agreed, structure for the secondary and tertiary care management of patients with anterior urethral strictures, and those secondary to posterior urethral trauma.

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Contributorship

SB and SRP researched the literature and conceived the statement with ARM on behalf of the British Association of Genito-Urethral Reconstructive Surgeons (BAGURS). They were all

involved in statement development. IE and SRP were responsible for the Delphi process. SB and SRP wrote the first draft of the manuscript. All authors reviewed and edited the manuscript and approved the submitted final version.

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References

1. Payne SR, Fowler S and Mundy AR. Analysis of a 7-year national online audit of the management of open reconstructive urethral surgery in men. *Br J Urol Int* 2019; 125: 304–313.
2. Santucci RA, Joyce GF and Wise M. Male urethral stricture disease. *J Urol* 2007; 177(5): 1667–1674.
3. Anger JT, Buckley JC, Santucci RA, et al. Trends in stricture management among male Medicare beneficiaries: underuse of urethroplasty? *Urology* 2011; 77(2): 481–485.
4. Mundy AR and Andrich DE. Urethral strictures. *BJU Int* 2011; 107(1): 6–26.
5. UK Government. Hospital Admitted Patient Care Activity, 2016-17: Diagnosis xls. *NHS Digital*, https://digital.nhs.uk/data-and-information/publications/statistical/hospital-admitted-patient-care-activity/2016-17 (accessed June 2020).
6. NHS Improvement. Archived reference costs. 2016/2017 reference costs: reference costs and guidance National schedule of reference costs - The main schedule.xlsx, https://improvement.nhs.uk/resources/reference-costs/2016/17 (accessed June 2020).
7. Wessells H, Angermeier KW, Elliott S, et al. Male urethral stricture: American Urological Association Guideline. *J Urol* 2017; 197(1): 182–190.
8. Stewart L, McCammon K, Metro M, et al. SIU/ICUD consultation on urethral strictures: anterior urethra-lichen sclerosus. *Urology* 2014; 83(3): S27–S30.
9. Morey AF, Watkin N, Shenfeld O, et al. SIU/ICUD consultation on urethral strictures: anterior urethra – primary anastomosis. *Urology* 2014; 83(3): S23–S26.
10. Latini JM, McAninch JW, Brandes SB, et al. SIU/ICUD consultation on urethral strictures: epidemiology, etiology, anatomy, and nomenclature of urethral stenoses, strictures, and pelvic fracture urethral disruption injuries. *Urology* 2014; 83(3): S1–S7.
11. Gomez RG, Mundy T, Dubey D, et al. SIU/ICUD consultation on urethral strictures: pelvic fracture urethral injuries. *Urology* 2014; 83(3): S48–S58.
12. Chapple C, Andrich D, Atala A, et al. SIU/ICUD consultation on urethral strictures: The management of anterior urethral stricture disease using substitution urethroplasty. *Urology* 2014; 83(3): S31–S47.
13. Buckley JC, Heyns C, Gilling P, et al. SIU/ICUD consultation on urethral strictures: dilation, internal urethrotomy, and stenting of male anterior urethral strictures. *Urology* 2014; 83(3): S18–S22.
14. Angermeier KW, Rourke KF, Dubey D, et al. SIU/ICUD consultation on urethral strictures: evaluation and follow-up. *Urology* 2014; 83(3): S8–S17.
15. Dalkey N and Helmer O. An experimental application of the Delphi method to the use of experts. *Manag Sci* 1963; 9(3): 458–467.
16. Nuss GR, Granieri MA, Zhao LC, et al. Presenting symptoms of anterior urethral stricture disease: a disease specific, patient reported questionnaire to measure outcomes. *J Urol* 2012; 187(2): 559–562.
17. Jackson MJ, Chaudhury I, Mangera A, et al. A prospective patient-centred evaluation of urethroplasty for anterior urethral stricture using a validated patient-reported outcome measure. *Eur Urol* 2013; 64(5): 777–782.
18. Rosen RC, Cappelleri JC, Smith MD, et al. Development and evaluation of an abridged, 5-item version of the International Index of Erectile Function (IIEF-5) as a diagnostic tool for erectile dysfunction. *Int J Impot Res* 1999; 11(6): 319–326.
19. Wessels SG and Heyns CF. Prospective evaluation of a new visual prostate symptom score, the international prostate symptom score, and uroflowmetry in men with urethral stricture disease. *Urology* 2014; 83(1): 220–224.
20. Buckley JC, Wu AK and McAninch JW. Impact of urethral ultrasonography on decision-making in anterior urethroplasty. *BJU Int* 2012; 109(3): 438–442.
21. Andrich DE and Mundy AR. What is the best technique for urethroplasty? *Eur Urol* 2008; 54(5): 1031–1041.
22. Jhanwar A, Kumar M, Sankhwar SN, et al. Holmium laser vs. conventional (cold knife) direct visual internal urethrotomy for short-segment bulbar urethral stricture: Outcome analysis. *Can Urol Assoc J* 2016; 10(5–6): E161–E164.
23. Yenice MG, Seker KG, Sam E, et al. Comparison of cold-knife optical internal urethrotomy and holmium:YAG laser internal urethrotomy in bulbar urethral strictures. *Cent Eur J Urol* 2018; 71(1): 114–120.
24. Steenkamp JW, Heyns CF and de Kock ML. Internal urethrotomy versus dilation as treatment for male urethral strictures: a prospective, randomized comparison. *J Urol* 1997; 157(1): 98–101.
25. Frost A, Bugeja S, Campos Juanatey F, et al. Is there still a role for urethral dilatation in the modern management of bulbar urethral strictures? *Eur Urol Suppl* 2018: 17: e593.
26. Naude AM and Heyns CF. What is the place of internal urethrotomy in the treatment of urethral stricture disease? *Nat Clin Pr Urol* 2005; 2(11): 538–545.
27. Pain JA and Collier DG. Factors influencing recurrence of urethral strictures after endoscopic urethrotomy: the role

of infection and peri-operative antibiotics. *Br J Urol* 1984; 56(2): 217–219.
28. Desmond AD, Evans CM, Jameson RM, et al. Critical evaluation of direct vision urethrotomy by urine flow measurement. *Br J Urol* 1981; 53(6): 630–633.
29. Ali L, Shahzad M, Orakzai N, et al. Efficacy of mitomycin C in reducing recurrence of anterior urethral stricture after internal optical urethrotomy. *Kor J Urol* 2015; 56(9): 650–655.
30. Mazdak H, Meshki I and Ghassami F. Effect of mitomycin C on anterior urethral stricture recurrence after internal urethrotomy. *Eur Urol* 2007; 51(4): 1089–1092; discussion 1092.
31. Zhang K, Qi E, Zhang Y, et al. Efficacy and safety of local steroids for urethra strictures: a systematic review and meta-analysis. *J Endourol* 2014; 28(8): 962–968.
32. Jackson MJ, Veeratterapillay R, Harding CK, et al. Intermittent self-dilatation for urethral stricture disease in males. *Cochrane Database Sys Rev* 2014; 19(12): CD010258.
33. Albers P, Fichtner J, Bruhl P, et al. Long-term results of internal urethrotomy. *J Urol* 1996; 156: 1611–1614.
34. Pansadoro V and Emiliozzi P. Internal urethrotomy in the management of anterior urethral strictures: long-term follow-up. *J Urol* 1996; 156(1): 73–75.
35. Al Taweel W and Seyam R. Visual internal urethrotomy for adult male urethral stricture has poor long-term results. *Adv Urol* 2015; 2015: 656459.
36. Greenwell TJ, Castle C, Andrich DE, et al. Repeat urethrotomy and dilation for the treatment of urethral stricture are neither clinically effective nor cost-effective. *J Urol* 2004; 172(1): 275–277.
37. Rourke KF and Jordan GH. Primary urethral reconstruction: the cost minimized approach to the bulbous urethral stricture. *J Urol* 2005; 173(4): 1206–1210.
38. Goulao B, Carnell S, Shen J, et al. Surgical treatment for recurrent bulbar urethral stricture: a randomised open label superiority trial of open urethroplasty versus endoscopic urethrotomy (The OPEN Trial). *Eur Urol Suppl* 2019; 18(1): e523.
39. Pansadoro V and Emiliozzi P. Internal urethrotomy in the management of anterior urethral strictures: long-term followup. *J Urol* 1996; 156(1): 73–75.
40. Hudak SJ, Atkinson TH and Morey AF. Repeat transurethral manipulation of bulbar urethral strictures is associated with increased stricture complexity and prolonged disease duration. *J Urol* 2012; 187(5): 1691–1695.
41. Lubahn JD, Zhao LC, Scott JF, et al. Poor quality of life in patients with urethral stricture treated with intermittent self-dilation. *J Urol* 2014; 191(1): 143–147.
42. Fall B, Sow Y, Diallo Y, et al. Urethroplasty for male urethral strictures: experience from a national teaching hospital in Senegal. *Afr J Urol* 2014; 20(2): 76–81.
43. Cavalcanti AG, Costa WS, Baskin LS, et al. A morphometric analysis of bulbar urethral strictures. *BJU Int* 2007; 100(2): 397–402.
44. Mundy AR. Anastomotic urethroplasty. *BJU Int* 2005; 96(6): 921–944.
45. Terlecki RP, Steele MC, Valadez C, et al. Grafts are unnecessary for proximal bulbar reconstruction. *J Urol* 2010; 184(6): 2395–2399.
46. Abouassaly R and Angermeier KW. Augmented anastomotic urethroplasty. *J Urol* 2007; 177(6): 2211–2216.
47. Galegos MA and Santucci RA. Advances in urethral stricture management. *F1000Res* 2016; 5: 2913.
48. Eltahawy EA, Virasoro R, Schlossberg SM, et al. Long-term follow up for excision and primary anastomosis for anterior urethral strictures. *J Urol* 2007; 177(5): 1803–1806.
49. Mundy AR and Andrich DE. Non-transecting bulbar urethroplasty. In: Brandes SB and Morey AF (eds). *Advanced Male Urethral and Genital Reconstructive Surgery*. Totowa, NJ: Humana Press, 2014, pp. 531–40.
50. Bugeja S, Andrich DE and Mundy AR. Non-transecting bulbar urethroplasty. *Transl Androl Urol* 2015; 4(1): 41–50.
51. Andrich DE and Mundy AR. Non-transecting anastomotic bulbar urethroplasty: a preliminary report. *BJU Int* 2012; 109(7): 1090–1094.
52. Barbagli G, Guazzoni G and Lazzeri M. One-stage bulbar urethroplasty: retrospective analysis of the results in 375 patients. *Eur Urol* 2008; 53(4): 828–833.
53. Xu Y-M, Li C, Xie H, et al. Intermediate-term outcomes and complications of long segment urethroplasty with lingual mucosa grafts. *J Urol* 2017; 198(2): 401–406.
54. Rourke K, McKinny S and St Martin B. Effect of wound closure on buccal mucosal graft harvest site morbidity: results of a randomized prospective trial. *Urology* 2012; 79(2): 443–447.
55. McAninch JW and Morey AF. Penile circular fasciocutaneous skin flap in 1-stage reconstruction of complex anterior urethral strictures. *J Urol* 1998; 159(4): 1209–1213.
56. Erickson BA, Breyer BN and McAninch JW. Single-stage segmental urethral replacement using combined ventral onlay fasciocutaneous flap with dorsal onlay buccal grafting for long segment strictures. *BJU Int* 2012; 109(9): 1392–1396.
57. Wessells H and McAninch JW. Current controversies in anterior urethral stricture repair: free-graft versus pedicled skin-flap reconstruction. *World J Urol* 1998; 16(3): 175–180.
58. Barbagli G, Palminteri E, Guazzoni G, et al. Bulbar urethroplasty using buccal mucosa grafts placed on the ventral, dorsal or lateral surface of the urethra: are results affected by the surgical technique? *J Urol* 2005; 174(3): 955–958.
59. Vasudeva P, Nanda B, Kumar A, et al. Dorsal versus ventral onlay buccal mucosal graft urethroplasty for long-segment bulbar urethral stricture: a prospective randomized study. *Int J Urol* 2015; 22(10): 967–971.
60. Joshi P, Kaya C and Kulkarni S. Approach to bulbar urethral strictures: which technique and when? *Turk Urol Derg* 2016; 42(2): 53–59.
61. Bugeja S, Ivaz S, Frost AV, et al. Non-transecting bulbar urethroplasty using buccal mucosa. *Afr J Urol* 2016; 22(1): 47–53.
62. Bubanj TB, Perovic S V, Milicevic RM, et al. Sexual behavior and sexual function of adults after hypospadias surgery: a comparative study. *J Urol* 2004; 171(5): 1876–1879.
63. Fenton AS, Morey AF, Aviles R, et al. Anterior urethral strictures: etiology and characteristics. *Urology* 2005; 65(6): 1055–1058.
64. Barbagli G, De Angelis M, Palminteri E, et al. Failed hypospadias repair presenting in adults. *Eur Urol* 2006; 49(5): 887–894; discussion 895.

65. Joshi PM, Barbagli G, Batra V, et al. A novel composite two-stage urethroplasty for complex penile strictures: a multicenter experience. *Ind J Urol* 2017; 33(2): 155–158.
66. Asopa HS, Garg M, Singhal GG, et al. Dorsal free graft urethroplasty for urethral stricture by ventral sagittal urethrotomy approach. *Urology* 2001; 58: 657–659.
67. Meeks JJ, Barbagli G, Mehdiratta N, et al. Distal urethroplasty for isolated fossa navicularis and meatal strictures. *BJU Int* 2012; 109(4): 616–619.
68. Venn SN and Mundy AR. Urethroplasty for balanitis xerotica obliterans. *Br J Urol* 1998; 81(5): 735–737.
69. Mundy AR and Andrich DE. Urethral strictures. *BJU Int* 2011; 107(1): 6–26.
70. Campos-Juanatey F, Bugeja S, Ivaz SL, et al. Management of penile urethral strictures: challenges and future directions. *World J Clin Urol* 2016; 5(1): 1–10.
71. Orandi A. One-stage urethroplasty. *Br J Urol* 1968; 40(6): 717–719.
72. McAninch JW. Reconstruction of extensive urethral strictures: circular fasciocutaneous penile flap. *J Urol* 1993; 149(3): 488–491.
73. Kulkarni SB, Joshi PM and Venkatesan K. Management of panurethral stricture disease in India. *J Urol* 2012; 188(3): 824–830.
74. Kulkarni S, Kulkarni J, Surana S, et al. Management of panurethral stricture. *Urol Clin North Am* 2017; 44(1): 67–75.
75. Barbagli G, De Angelis M, Romano G, et al. Clinical outcome and quality of life assessment in patients treated with perineal urethrostomy for anterior urethral stricture disease. *J Urol* 2009; 182(2): 548–557.
76. Summerton DJ, Djakovic N, Kitrey ND, et al. *EAU Guidelines on Urological Trauma: Limited Update March 2016*, https://uroweb.org/wp-content/uploads/EAU-Guidelines-Urological-Trauma-2016-1.pdf (2016, accessed February 2020).
77. Webster GD, Mathes GL and Selli C. Prostatomembranous urethral injuries. a review of the literature and a rational approach to their management. *J Urol* 1983; 130: 898–902.
78. Koraitim MM. Pelvic fracture urethral injuries: evaluation of various methods of management. *J Urol* 1996; 156(4): 1288–1291.
79. Leddy LS, Vanni AJ, Wessells H, et al. Outcomes of endoscopic realignment of pelvic fracture associated urethral injuries at a level 1 trauma center. *J Urol* 2012; 188(1): 174–178.
80. Raney AM, Scott MP, Brownstein PK, et al. Urethral injury: experimental study. *Urology* 1977; 9(3): 281–283.
81. Koraitim MM. Unsuccessful outcomes after posterior urethroplasty: definition, diagnosis, and treatment. *Urology* 2012; 79(5): 1168–1173.
82. Singh BP, Andankar MG, Swain SK, et al. Impact of prior urethral manipulation on outcome of anastomotic urethroplasty for post-traumatic urethral stricture. *Urology* 2010; 75(1): 179–182.
83. Culty T and Boccon-Gibod L. Anastomotic urethroplasty for posttraumatic urethral stricture: previous urethral manipulation has a negative impact on the final outcome. *J Urol* 2007; 177(4): 1374–1377.
84. Cooperberg MR, McAninch JW, Alsikafi NF, et al. Urethral reconstruction for traumatic posterior urethral disruption: outcomes of a 25-year experience. *J Urol* 2007; 178(5): 2006–2010; discussion 2010.
85. Mundy AR. Urethroplasty for posterior urethral strictures. *Br J Urol* 1996; 78(2): 243–247.
86. Choudhary S, Singh P, Sundar E, et al. A comparison of sonourethrography and retrograde urethrography in evaluation of anterior urethral strictures. *Clin Radiol* 2004; 59(8): 736–742.
87. Erickson BA, Breyer BN and McAninch JW. The use of uroflowmetry to diagnose recurrent stricture after urethral reconstructive surgery. *J Urol* 2010; 184(4): 1386–1390.
88. Goonesinghe SK, Hillary CJ, Nicholson TR, et al. Flexible cystourethroscopy in the follow-up of posturethroplasty patients and characterisation of recurrences. *Eur Urol* 2015; 68(3): 523–529.
89. Payne SR, Fowler S and Mundy AR. The logistic management of tertiary urethral disease in the United Kingdom; implications from an on-line audit of male reconstructive urethral surgery. *J Clin Urol* 2020. Epub ahead of print 14 January. DOI: https://doi.org/10.1177/2051415819894182