Title:

UROLOGICAL SOCIETY OF INDIA GUIDELINES ON URETHRAL STRICTURE:

Keywords: USI, stricture Urethra, Guidelines, Hypospadias, Pelvic fracture, Penile stricture, Bulbar stricture, Panurethral stricture, Buccal mucosal graft , Skin graft, Dorsal inlay, Ventral inlay. Complication of hypospadias .

Recommendations

We have two levels of recommendations, strong and weak. A two-level system is simple and allows easy interpretation of strategy that will benefit the majority of patients. If the advantages are not predictable or uncertainty exists about the extent of benefits and risks, we have made a weak recommendation.

For decisions where benefits far outweigh risks, or risks far outweigh benefits we have made a strong recommendation. In atypical circumstances the clinician should carefully consider the benefits, risks, and patient preferences carefully before arriving at a decision[1]

INTRODUCTION:

Urethral strictures are known to mankind for 5000 years. Sushruta described methods of dilatation and urethrotomy between 6^{th} to 8^{th} century BC which was much ahead of time[2] . He also designed urethral probes and dilators. ~~Urethral strictures are still prevalent today~~. Prevalence of urethral strictures is increasing world over with increasing in road traffic injuries. India, with a population of 1.3 billion

and has innumerable (estimate) patients and every urologist has to treat these patients.

The global burden of urethral stricture disease in males has not been assessed. In The US, it has been estimated to affect up to 0.6% of population. The burden of Urethral stricture disease in India has not been reported but the etiology patterns have been reported in limited studies from men undergoing urethroplasty at reputed tertiary centres in India. A study from a tertiary centre from Eastern India reported on aetiology from over 400 patients over many years and reported iatrogenic as the most frequent cause. Urethral catheterisation was a more frequent cause than TUR in this population[3].A study comparing characteristics of strictures in men undergoing urethroplasty at leading centres in India and West suggested that Trauma related strictures were much more common in India (36% vs 15.8%) whereas the Iatrogenic were lesser (16% vs 35%). The Incidence of LS associated strictures was 3 times as compared to west (21.5% vs 6.9%) . Similarly, the number of panurethral strictures were almost two times that in west (18% vs 8.9%) whereas strictures involving only the penile urethra were 4 times less common (5.3% vs 27%). Regarding iatrogenic strictures, post TURP strictures were three times more common than in western population [4] in Indian subcontinent makes the case for Indian specific guidelines.

The average expenditure on healthcare by an individual with stricture is thrice that of a man without a stricture[5]. Moreover, Urethral stricture disease is more prevalent in younger economically productive men thereby causing huge economic burden.

India has 6% accident rates having about 1% of world automobiles ~~India has 1% of automobiles of the world with accident rates of 6%,~~ so having a large number of pelvic fracture urethral distraction defects.

Our disease presentation is different than the developed countries; ~~where~~ patients often remain ignorant and present late, many a times with a watering can perineum or renal failure. Pan urethral and long strictures are more common where treatment outcomes are inferior. [6] Tobacco use is another unique problem to the Indian subcontinent. Southeast Asia harbours close to 400 million tobacco users (including chewed and smoked tobacco) and according to an estimate approximately 47% of Indian males above 15 years are tobacco users. [7] The long-term outcomes of buccal mucosal graft in this population are inferior as compared to non-users as was reported in two Indian studies whereas the outcomes with lingual mucosa remain unaffected by tobacco. [8]

Moreover, the non-standardized definitions of diagnosis, treatment and follow up protocols are the reasons for less robust literature on the topic. However, the case load and available clinical expertise can guide us to format a guideline which will form the basis of standardizing the treatment protocols and guide further research in the field.

~~es.~~

Out of more than 2500 urologists in India, less than 200 responded to the stricture survey from the USI. A lot of burden lands with the government teaching institutes where there the wait list for urethroplasty can be as long as up to 2 years and 16% of patients on the waitlist develop complications. ~~and~~ An optimum waiting time calculated in a study is 43 days beyond which the complications start increasing[9]. We need to develop more centres of excellence for urethroplasty where patients could be referred and treated properly.

Definitions:

A. Urethral stricture (anatomical definition): A part of urethra with spongiosa and narrowing which interferes with normal dynamics of voiding is called a stricture.

B. Urethral stenosis / contracture: Narrowing of urethra without spongiosa

C. Distraction defect: A special type of urethral stenosis (or obliteration of the lumen) which typically occurs after pelvic fracture when the ends of the membranous and bulbar urethra are pulled apart.

Classification : A Classification of urethral stricture according to etiology

a. Inflammatory strictures: Due to infectious or non-infectious causes of inflammation

b. Traumatic strictures: Due to localized trauma- either iatrogenic or straddle injury

B Classification of urethral stricture according to length of affected segment

a. Short segment stricture: Less than 1 cm in length

b. Long segment stricture: More than 1 cm in length.

c. Complex urethral stricture: refers to a long segment or pan urethral stricture, recurrent urethral stricture, recto urethral fistula, prior failed urethroplasty, paediatric urethral strictures, bulbar urethral necrosis, urethral stricture with bladder neck incompetence, chronic kidney disease, pre-or post renal transplant or post treatment for prostate cancer, post radiotherapy or post high intensity focussed ultrasound(HIFU) among others.

C. Classification of urethral stricture according to site

Meatal strictures/ Meatal stenosis

Fossa navicularis stricture

Penile urethral stricture

Bulbar urethral stricture

Panurethral stricture

Pelvic fracture urethral distraction defect

Bladder neck contracture

Type of procedures:

1. Dorsal onlay graft~~ing~~/ flap : Placing the graft on the corpora after dissection the urethra off in the midline.
2. Ventral graft~~ing~~/ flap: Placing the graft after incising the urethra on its ventral aspect.
3. Double face Buccal mucosal/ skin graft urethroplasty: Refers to dorsal inlay with ventral onlay or ventral inlay with dorsal onlay technique.

Clinical principles (applies to all strictures):

Pre- operative:

Preoperative work up includes: Urine routine and Urine culture, Uroflowmetry (if able to void))

Ultrasound of the upper tracts and post void residual urine

Strong recommendations

Imaging:

Retrograde Urethrography (RGU) and

Micturating cystourethrogram (MCU) alternatively called as Voiding cystourethrogram (VCUG).

Intraoperative:

Injection of methylene blue: (it stains the diseased epithelium) in urethra in all inflammatory strictures is recommended.

Drain: The type of drain and the decision to use a drain at the site of surgery is the discretion of the surgeon. The panel especially recommends drainage in cases of difficult urethroplasty or continuous ooze.

Role of urethral dilatation: There is no role for blind, metal dilatation. Strong recommendation.

The preferred method is passing a guide wire and using Teflon coated plastic dilators over the wire. Alternatively, small calibre endoscopy can be used to pass guide wire
Balloon dilatation is a method of non-traumatic dilatation

Management options according to stricture location:

1. MEATAL /FOSSA NAVICULARIS STRICTURES

Normal meatus as defined by Turner Warwick et al is around 25 Fr. Currently no Indian study is available for the standard size of the meatus. Indian study measuring the length of the urethra, did not look at the meatal calibre. [10] Symptomatic abnormal narrowing is meatal stenosis or stricture (Usually narrowing by one third should become symptomatic). However, there are no objective diagnostic criteria in literature.

Etiology

Lichen sclerosus
Iatrogenic trauma (Catheter), post-surgery (Post TURP or hypospadias)
Congenital
Infective/Inflammatory
Malignancy

Clinical evaluation

Thorough examination: size of the meatus, discoloration, any inflammatory changes in glans or prepuce, associated phimosis, and palpation of the urethra completely and visual impression of the urinary stream of the patient/ meatal calibration

Changes for Lichen sclerosus, look out for changes of malignancy

Uroflowmetry (Clinical recommendation 2) especially for a baseline evaluation and for post-operative follow up

Meatal Calibration

Dye Study: Retrograde urethrography (May need an intravenous cannula for narrow meatus and may need supervision by a urologist) is needed for evaluation of proximal urethra. Voiding Cystourethrogram may be needed depending on the retrograde urethrography findings.

Sonography can assess the upper tracts when clinically indicated.

Endoscopic evaluation by using small caliber endoscopes i.e. paediatric cystoscope or ureteroscope if mandated by clinical settings or retrograde dye evaluation.

Treatment

1. Meatal dilatation

   Is palliative, can tide over emergency situation or in certain post-operative settings. In children for congenital and paediatric meatal stenosis it necessitates multiple treatments over long duration and results are not durable. [11,12]
2. Meatotomy (Ventral) is the first line of treatment when possible.
3. Meatoplasty is procedure of choice for failed meatotomy or recurrent meatal stenosis. Meatoplasty can be done with dorsal inlay graft meatoplasty (Buccal graft first choice, Preputial skin graft as alternative

for inflammatory etiology excluding lichen sclerosus): Strong recommendation. Alternatively, local skin flaps (e.g. Jordan flap) can be used for meatoplasty: Weak recommendation. The flaps are useful when either ideal graft is not available or the surrounding tissues do no provide good vascular bed for the graft.

2.PENILE STRICTURES

Etiology

Lichen sclerosus
Failed hypospadias repair
Iatrogenic: Catheter induced or instrumentation
Traumatic
Inflammatory non-LS

Evaluation

Retrograde urethrography and Voiding cystourethrography
Upper tract evaluation using Ultrasonography

Treatment

Urethral dilatation: Palliative, patient must be informed about the non-curative role of the treatment
Patient unfit for surgery, Patient refuses surgery and after multiple failed surgeries

Weak recommendation

DVIU: Not recommended: Strong recommendation

Self-catheterization: Palliative, patient must be informed about the non-curative role of the treatment

Patient unfit for surgery, Patient refuses surgery and after multiple failed surgeries

Weak Recommendation

Surgery /Urethroplasty

Non-LS: Urethral calibre reasonable (More than or equal to 7 Fr): Single stage Buccal mucosa urethroplasty either dorsal onlay or dorsal inlay Orandi flap/ Local skin flap/ inner prepucial flap Weak recommendation

If urethral calibre is narrower; Two staged urethroplasty

Johannsson's in first stage and Asopa dorsal inlay graft urethroplasty in the second

Lichen sclerosus

Single staged buccal mucosa, dorsal onlay /inlay technique

Ventral application of free graft is not recommended

Strong recommendation

2.Penile Stricture:

2.1 Dorsal inlay buccal graft augmentation urethroplasty is the first choice of procedure-Strong recommendation - strong evidence is not available [13])

2.2 Dorsal free skin graft (inner preputial/non-hair bearing)-Second choice or preputial flap

2.3 Incise stricture ventrally with ventral genital skin onlay flap (when there is reasonable urethral plate forming at least one third ^{of} circumference)

2.4 Dorsal buccal graft with ventral genital skin flap /Inner prepucial flap (When there is reasonable spongiosum)

2.5 Johannsson's Stage I with Asopa dorsal buccal inlay and tubularisation in second stage (hardly any urethral plate)

2.6 Two staged buccal urethroplasty (Insert buccal in first stage and tubularisation. Warn patients of graft contraction and possibility of redo grafting) [15,16,17]

2.7 Stricture with diverticulum – (use diverticular flap to augment the stricture in single stage. Diverticulum usually occurs due to distal narrowing.)

3.Bulbar Strictures:

Etiology:

a. Non-Traumatic:
   - Lichen Sclerosus
   - Catheter /instrument
   - Inflammatory –Non-LS

b. Traumatic

Evaluation:

RGU with MCU/VCUG along should be performed in all cases.

Role of Urethrosonography:

· It is preferred in academic settings with limited role.

- The Urethrosonography should be performed/supervised by treating urologist.
- In long strictures, there could be intervening normal urethra with block at 2 ends. Urethrosonography is useful for identifying the intervening urethra
- It can help in identifying proximal stones, tumors particularly if the retrograde contrast does not reach the segment of urethra proximal to the stricture.

Treatment:

Non Traumatic Bulbar Strictures:

1.Dilatation/ Direct Visual internal urethrotomy (DVIU):

Single dilatation/DVIU may be offered to patients with single, short, non-traumatic, bulbar urethral strictures who desire that option after explaining the high rate of recurrence and the possible need for secondary treatment -Strong recommendation

Self calibration after DVIU for management of bulbar strictures is not recommended.[18]

2.Urethroplasty:

Ventral versus dorsal onlay:

A 16 Fr Nelaton catheter is passed from the from meatus and define the distal extent of stricture in relation to upper border of bulbo spongiosus muscle

If the catheter tip is felt below the upper border bulbospongiosus muscle ,ventral approach is preferred. If the catheter tip is felt above the upper border of bulbospongiosus muscle, dorsal approach is preferred. (Expert Opinion)

2.1 For proximal bulbar strictures with good healthy, spongiosa ventral onlay buccal augmentation arthroplasty is first choice procedure.

2.2 For Obese patients, young sexually active and Post TURP proximal bulbar strictures Ventral onlay buccal augmentation urethroplasty remains the first choice procedure.[19]

2.3 Dorsal approach techniques:

a. Barbagli-Circumferential mobilization [20]
b. Kulkarni-One side dissection [21]
c. Asopa –Dorsal inlay [22]

2.4 Non-transecting bulbar urethroplasty:

This involves incising the urethra dorsally and assessment of the urethral plate. If the stricture is short segment, ventral mucosa can be excised and stricturoplasty performed.[23]

Traumatic Bulbar Strictures:

3.1 There is no role for DVIU in traumatic bulbar strictures -Strong recommendation

3.2 Short Stricture-Excision with anastomotic urethroplasty if the procedure of choice

3.3 Long stricture/failed anastomotic urethroplasty- Augmented anastomotic urethroplasty is recommended. [24]

Post Hypospadias surgery urethral strictures:

It is a complex type of stricture disease which is difficult to treat owing to multiple previous treatments, difficult host bed for any further reconstruction and unreliable tissue vascularity. The incidence varies from 5 to 10% (13) and is more common in proximally repaired strictures. [13]

These may be seen in adult or post pubescent onset urethral strictures following early childhood repair

The neourethral or native urethral strictures may be managed using the following clinical guidelines

Should we classify them into early (less than 3 months after repair) stricture and late strictures? No

Time : Within One year– Any time

Location : Anywhere in neo-urethra

Common site- original Meatus/anastomotic

Predisposing Factors :

a. Tension on repair

b. Tissue Ischaemia

c. Inappropriate design of Neourethra

d. Infection

e. Trauma - Instrumentation - Large Catheters

f. Inadequate Glanular tunneling

g. Tight Glanular wrap

Management

1. **Urethral Dilatation**
2. **VIU**
3. **Excision primary anastomosis**
4. **Replaement Urethroplasty**

(Free, Pedicle and Tube Grafts)

Adjacent skin grafts/ flaps

- Buccal mucosal grafts – single/ two stage

- Bladder mucosa

In most cases, initial management is conservative and consists of dilation or endoscopic treatment. Attempts at repeated dilation or urethrotomy in these patients are usually not successful and should be discouraged because of the possibility of worsening the existing fibrosis. The outcome tends to be better for short anastomotic strictures and when conservative treatment is initiated ≤3 months after operation.

Strictures not responding to initial dilation and those noted to be extensive on the initial evaluation generally require revision / replacement urethroplasty.

1.Bulbar Strictures:

This is iatrogenic/catheter /dilatation induced.

There is no role for excision and primary anastomosis: Strong Recommendation

1.1 Short Stricture-Single DVIU

1.2 Dorsal augmentation with buccal graft –Strong recommendation but we do not have very strong studies. Low volume retrospective studies although all favour dorsal inlay or onlay(Ref1)

1.3 Alternative free grafts can be inner preputial skin flap if available or other sites of non hair bearing skin.

2.Penile Stricture:

2.1 Dorsal inlay Buccal graft augmentation urethroplasty is the first choice of procedure-Strong recommendation - strong evidence is not available [13])

2.2 Dorsal free skin graft (inner preputial/non-hair bearing)-Second choice or preputial flap

2.3 Incise stricture ventrally with ventral genital skin onlay flap (when there is reasonable urethral plate forming at least one third of circumference)

2.4 Dorsal Buccal Mucosal graft with ventral genital skin flap /Inner prepucial flap (When there is reasonable spongiosum)

2.5 Johannsson's Stage I with Asopa dorsal buccal inlay and tubularization in second stage (hardly any urethral plate)

2.6 Two staged buccal urethroplasty (Insert buccal in first stage and tubularisation. Warn patients of graft contraction and possibility of redo grafting) [15,16,17]

2.7 Stricture with diverticulum – (use diverticular flap to augment the stricture in single stage. Diverticulum usually occurs due to distal narrowing.)

3.Fossa Navicularis/Meatal stenosis:

3.1 Single dilatation

3.2 Dorsal inlay Buccal /non-hair bearing skin graft augmentation

Radiation Strictures:

- Results are guarded in radiation induced bulbar strictures.
- Surgical options include anastomotic Urethroplasty, flaps or free graft augmentation. Flaps are recommended over free grafts .
- Perineal Urethrostomy /Scrotal dropback are salvage procedures.

Post Transurethral resection (TUR) proximal Bulbar Strictures:

Sphincter is an omega shaped structure with deficiency towards posterior wall towards rectum. The strictures post TUR are mostly proximal bulbar and not membranous strictures. Ventral onlay buccal graft augmentation without incising the full thickness of the urethra is the procedure of choice; it preserves continence.

4.Panurethral Strictures:

Etiology:

- Lichen Sclerosis
- Iatrogenic (catheter, instrumentation, repeated DVIU, bipolar TURP using sheath as return electrode)
- Inflammatory

Evaluation:

In patients with Lichen Sclerosus who have a red patch on glans, biopsy is indicated to rule out malignancy. If oral mucosa is not available for graft harvest and one wants to use genital skin, it is essential to biopsy and rule out lichen Sclerosus.

Treatment:

4.1 Dilatation: Can be used in patients for palliation, unfit for surgery, refuses surgery

4.2 DVIU: There is no role for DVIU–Strong recommendation

4.3 Single stage, Buccal Mucosal graft, dorsal onlay skin graft/ flap augmentation is the first-choice procedure (Kulkarni technique)-Strong recommendation

The largest retrospective series of 117 patients from India claimed 88.5% success rates with a mean follow up close to 5 years (Level of Evidence 3) [25] The results of Kulkarni technique have been reproduced in a recent large (n=73) retrospective multiinstitution study with 1 year patient reported outcome success rates of 88%. [26]

4.4 Two stage urethroplasty (Johannsson's in first stage with /without dorsal inlay Buccal Mucosal augmentation) can be performed in obliterate strictures.

4.5 Non-Lichen Sclerosus –Fascio cutaneous genital flaps can be performed –Weak recommendation

4.6 Perineal Urethrostomy –Salvage procedure.

In a retrospective series comparing results of Single stage (Kulkarni) BMG vs 2 stage (Jhohanson-Bracka) urethroplasty in LS associated Long strictures >8cm), there was a significant difference in QoL favouring single stage urethroplasty without a compromise in postoperative outcomes. Treatment of long anterior urethral stricture associated to lichen sclerosus [27]. And in another study 54 patients with biopsy proven LS associated long strictures (mean length 12.5 cm) were subjected to single stage urethroplasty with 88% success rates. [28]

5.Pelvic Fracture Urethral Distraction Defects:

5.1 Immediate SPC with delayed urethroplasty is the standard of care - Strong recommendation

5.2 Primary endoscopic realignment in stable patients -Weak recommendation

Evaluation:

RGU with MCU both should be performed. In case bladder neck does not open, prior alfa blockers can be given and MCU repeated. Rarely there can be bladder neck injury with complete obliteration which can be diagnosed with endoscopy from SPC tract.

Penile Doppler: Penile Doppler with intracevrnosal Papavarine injection is used to document erection, blood flow in cavernosal and dorsal penile arteries.

Endoscopy: Intraoperative urethroscopy to assess distal urethra and cystoscopy through SPC tract. It helps assessing bladder, bladder neck and prostatic urethra. In patients with no suprapubic access, either establish a SPC tract a week before or perform intraoperative SPC access.

MRI:

- Double block: In those patients where there is obliteration at bladder neck in PFUD, Urethroplasty is deferred . This are patients with double block (Bulb membranous and Bladder neck prostate) and require additional transpubic approach by experts. Possibility of incontinence needs to be discussed with the patient and relatives.
- Recto urethral fistula
- Long defects with wide diathesis

CT Scan:

- Severely distorted pelvis
- Multiple fragments of pubic bone indenting the bladder neck
- Bladder neck trauma

Treatment:

5.3 Anastomotic Urethroplasty with simple/elaborated perineal approach is the standard of care

a. If bougie is not felt in perineum, finger can be inserted in rectum to feel the direction of posterior urethra

b. Adequate scar excision, optimal crural separation and inferior pubectomy when needed are steps in performing tension free bulbo membranous anastomosis.

c.Supracrural rerouting should not be performed unless indicated.

5.4 Perineo abdominal repair with omental wrap may be required for complex cases.

5.5 Children, recto urethral fistula and complex urethroplasties should be managed with help from experts-Strong recommendation

5.6 For long primary gaps pedicled skin tube/perineal urerthrostomy is not recommended as primary procedure but may be useful as salvage procedure.

Bulbar Urethral Necrosis:

This occurs due to inadequate retrograde blood supply. The bulbar urethra necrosis and patients are left with penile urethra and posterior urethra.

The first choice of treatment is pedicled preputial or distal penile skin tube.

Alternative procedures include Turner Warwick Scrotal dropback and Enterourethroplasty.

Recto urethral Fistula:

a. Approach can be perineal /abdominal perineal with tissue interposition:

Omentum, Dartos pedicle flap, gracilis can be used as interposition.

b. Diverting colostomy and SPC is advisable (double diversion).

DVIU (Direct visual internal urethrotomy):

6.1 Post urethroplasty ring stricture can be managed with DVIU
Post urethroplasty ring strictures signify limited degree of fibrosis at either proximal or distal anastomotic sites as against the full graft fibrosis. DVIU has been reported as a treatment modality for these kinds of recurrences. [29] However the long-term outcomes of DVIU in this situation are not available in literature.

6.2 Laser DVIU and cold knife DVIU –results are same. [30]
6.3 Laser DVIU is an expensive way of doing DVIU
6.4 Laser DVIU should be used like a knife to make incisions and circumferential vaporization at stricture site should be avoided. [31]

6.5 Catheter after DVIU should be removed in less than 72 hours. Long term catheterization has no role. Though the optimum duration of catheterization after DVIU is not known. Some limited retrospective data with inherent inclusion bias suggests that shorter catheterization duration may be beneficial. [32]
6.6 Intraurethral injection of Mitomycin and other adjuvant agents are not recommended at present (Except in bladder neck). One RCT with questionable methodology has shown better outcomes in short term with Mithomcyin C, however long term outcomes have never been published by same group. Similarly, steroid injection after intraurethral incision lack long term outcomes (> 1 year) in literature. [33,34,35,]

6.7 Intermittent Self Dilatation after DVIU may have preventive effect (LE 2 or 3 metanalysis of poorly designed RCT , Grade of recommendation Weak) [36]

Bladder Neck Contracture:

This term denotes stenosis of either anatomical bladder neck (e.g. Post TURP) or the vesicourethral stenosis post Radical prostatectomy.

Etiology:

a.Post-Surgical:

Radical prostatectomy

TURP

Open Prostatectomy

b.Trauma

c.Radiation: Most common site of the stenosis after Radiotherapy of prostate cancer (especially Brachytherapy) is bulbomembranous junction rather than bladder neck. [37,38]

.

Treatment:

7.1 Urethral dilatation is a treatment option in post Radical prostatectomy vesicourethral stenosis. Most of the early stenosis (< 6 weeks) are amenable to dilation and some show good long term response. [39,40]

7.2 Endoscopic Bladder neck incisions with cold knife is the procedure of choice in post TURP bladder neck contracture and those vesicourethal anastomotic strictures that are not amiable to urethral dilatation. [41,42,43] Laser BNI is also feasible and recommended as second choice. [45]

7.3 Intralesional injection of mitomycin/steroids can be tried in recurrent cases-Weak recommendation. [46]

7.4 Open/Robotic Y-V Plasty and its modifications along with end to end anastomosis for recalcitrant vesicourethral stenosis and bladder neck contracture post TURP has been described.[47,48,49]

Special Situations:

1.Female Urethral Strictures:

No standard defination exists for a normal calibre in women. Variably called stricture or stenosis. The lack of spongiosa in the female urethra may make urethral stenosis a better term (Expert opinion).

a.Traumatic-

b.Non traumatic

Diagnosis:

MCU, Small caliber endoscopy and Urodynamics.

Management:

a.Traumatic:

Anastomotic Urethroplasty (Children: abdominal approach; Adults vaginal approach. (Expert opinion)

b.Non Traumatic:

Since the incidence is very rare (8 percent of all confirmed utofynamic BOO, it is Important to confirm bladder outlet obstruction before surgery by a urethroscopy with a small calibre cystoscopy in all suspected patients . The results of urethroplasty may be sub optimal in patients with underactive detrusor. (Expert opinion)

Symptoms may be non specific. High index of suspicion is needed for diagnosis(Clinical principle).

- Dilatation: A single dilatation of a short segment stricture may be attempted. It is however rarely curative in established stenosis (Strong recommendation).
- Regular dilatation in females with LUTS and proven bladder outlet obstruction has little role
- Urethroplasty (onlay or inlay) can be offered when dilatation fails (Strong recommendation). Vaginal and buccal mucosa both are acceptable options
- Local flaps are also feasible especially for distal urethra
- Patients may be advised to stop dilatation for a month before urethroplasty to better delineate the extent and calibre of the stricture. (Expert opinion)

Supplementary therapy: In post menopausal women local estrogen cream can be prescribed long term.[50]

2.CRF and strictures (Pre/post Transplant):

Before performing renal transplant, lower urinary tract needs to stabilized.

- Urethroplasty is recommended before performing renal transplant.[50]
- These patient needs close follow up for both urethroplasty evaluation and renal transplant success.

- Post transplant urethroplasty have higher incidence of urinary tract infections.

3.Neurogenic bladder and CIC:

Patients who are on CIC for neurogenic bladder and develop stricture urethra can be managed with urethroplasty

4.Role of Urodynamics in Stricture Urethra:

- Chronic retention
- Large diverticulum
- Suspected underactive bladder
- Poor flow after urethroplasty

5.Urethral Stents:

- In today's era, Urethral stents have no role-Strong recommendation
- Complete obliteration after Urolume should be treated by dorsal approach (Stent removal with buccal mucosa urethroplasty single stage)

6.Gender Reassignment Surgery:

Strictures in such subtype of patients should done with help of expert

7.Restenosis after Perineal Urethrostomy:

1.Dilatation
2.Dorsal Oral mucosa graft augmentation
3.Lotus leaf flap technique.

Salvage and complex procedures should be only done when expert is available

Postoperative Care:

1. Wound examination in first week is recommended (clinical Principle)
2. Panel recommends catheter removal at three weeks if the operating surgeon is performing pericatheter urethrogram to rule out extravasation. If no pericatheter urethrogram is planned then catheter should be removed at least 4 weeks. For complex cases, the panel recommends to retain the catheter for 6 weeks.There is no benefit in retaining the catheter beyond 6 weeks. (level of Evidence 3, Grade of recommendation 4)
3. If an SPC has been retained after urethroplasty, it can be removed after ensuring adequate per urethral flow is ensured.
4. The panel recommends intravennous antibiotic cover for 48 hours and oral antibiotics for the period the catheter is indwelling. (Weak recommendation)

In a recent retrospective study examining the utility of portoperative pericatheter retrograde urethrogram performed on 130 patients done at an average of 25 days, extravasation was seen in in 11.5% patients. Stricture >10 cm had more chance of extravasation (43% vs 11%). The catheter was retained for further 2-3 weeks if extravasation was noted. (Novel pericatheter retrograde urethrogram technique is a viable method for postoperative urethroplasty imaging[51].Pericatheter RGU is not required after an anastomotic urethroplasty [52](

Follow up

Uroflow, consider flow more than 12 ml/s after a urethroplasty as optimal (McAninch)

Follow with Uroflow and PROM at 3, 6, 9 and 12 months and yearly follow up thereafter for long term.

Unsuitable Buccal Mucosa:

Tobacco chewing is common in the asian subcontinent.This may make the use of buccal mucosa unsuitable in some cases.The usual next choice of material is the lingual mucosa.The mucosal strips can be harvested from undersurface of tongue .Studies have reported using lingual mucosa for panurethral strictures,suggesting adequate availability.

In case the patient does not have Lichen Sclerosus,preputial skin graft or other non hair bearing genital skin grafts can be considered.Tissue engineering of buccal grafts may be the future and studies have already began in that direction.

Few studies have explored alternative donor tissues such as saphenous vein, tunica albuginea and rectal mucosa . This technique has not come in to the main stream reconstructive urology. Long term results are awaited.

Future Direction:

1.Many Centres of excellence should be developed for genitourinary reconstructive surgery.

2. Attempts at Tissue engineering for neo-urethra

References:

1. Guyatt GH, Oxman AD, Kunz R, Falck-Ytter Y, Vist GE, Liberati A, Schünemann HJ. Rating quality of evidence and strength of recommendations: Going from evidence to recommendations. BMJ: British Medical Journal. 2008 May 10;336(7652):1049.

2. Das S. Urology in ancient India. Indian journal of urology: IJU: journal of the Urological Society of India. 2007 Jan;23(1):2.

3. UroToday Int J. February; 6 (1): art 9.

4. Stein DM, Thum DJ, Barbagli G, Kulkarni S, Sansalone S, Pardeshi A, Gonzalez CM. A geographic analysis of male urethral stricture aetiology and location. BJU international. 2013 Oct;112(6):830-4.

5. Santucci RA, Joyce GF, Wise M. Male urethral stricture disease. The Journal of urology. 2007 May 1;177(5):1667-74

6. Yalcinkaya F, Zengin K, Sertcelik N, Yigitbasi O, Bozkurt H, Sarikaya T, Karabacak R. Dorsal onlay buccal mucosal graft urethroplasty in the treatment of urethral strictures-does the stricture length affect success?. Advances in clinical and experimental medicine: official organ Wroclaw Medical University. 2015;24(2):297-300.

7. Sinha DN, Palipudi KM, Rolle I, Asma S, Rinchen S. Tobacco use among youth and adults in member countries of South-East Asia region: review of findings from surveys under the Global Tobacco Surveillance System. Indian journal of public health. 2011 Jul 1;55(3):169.

8. Giovino GA, Mirza SA, Samet JM, Gupta PC, Jarvis MJ, Bhala N, Peto R, Zatonski W, Hsia J, Morton J, Palipudi KM. Tobacco use in 3 billion individuals from 16 countries: an analysis of nationally representative cross-sectional household surveys. The Lancet. 2012 Aug 18;380(9842):668-79..

9. Hoy NY, Chapman DW, Dean N, Rourke KF. Incidence and Predictors of Complications due to Urethral Stricture in Patients Awaiting Urethroplasty. The Journal of urology. 2018 Mar 1;199(3):754-9.

10. Krishnamoorthy V, Joshi PB. Length of urethra in the Indian adult male population. Indian journal of urology: IJU: journal of the Urological Society of India. 2012 Jul;28(3):297.

11.Searles JM, MacKinnon AE. Home-dilatation of the urethral meatus in boys. BJU Int. 2004;93(4):596-597.

12. Radojicic ZI, Perovic SV, Stojanoski KD. Calibration and dilatation with topical corticosteroid in the treatment of stenosis of neourethral meatus after hypospadias repair. BJU international. 2006 Jan;97(1):166-8.

13. Snodgrass WT, Bush NC. Management of urethral strictures after hypospadias repair. Urologic Clinics. 2017 Feb 1;44(1):105-11.

14. Scherz HC, Kaplan GW, Packer MG, Brock WA. Post-hypospadias repair urethral strictures: a review of 30 cases. The Journal of urology. 1988 Nov 1;140(5):1253-5.

15. Joshi PM, Barbagli G, Batra V, et al. A novel composite two-stage urethroplasty for complex penile strictures: A multicentre experience. Indian Journal of Urology. 2017;33(2):155-158.

16. Kolon TF, GONZALES Jr ET. The dorsal inlay graft for hypospadias repair. The Journal of urology. 2000 Jun 1;163(6):1941-3.

17. Asopa HS. Newer concepts in the management of hypospadias and its complications. Annals of the Royal College of Surgeons of England. 1998 May;80(3):161.

18. Dubey D. The current role of direct vision internal urethrotomy and self-catheterization for anterior urethral strictures. Indian journal of urology: IJU: journal of the Urological Society of India. 2011 Jul;27(3):392.

19. Joshi P, Kaya C, Kulkarni S. Approach to bulbar urethral strictures: Which technique and when?. Turkish journal of urology. 2016 Jun;42(2):53.

20. Barbagli G, Selli C, Tosto A, Palminteri E. Dorsal free graft urethroplasty. The Journal of urology. 1996 Jan 1;155(1):123-6.

21.Kulkarni S, Barbagli G, Sansalone S, Lazzeri M. One-sided anterior urethroplasty: a new dorsal onlay graft technique. BJU international. 2009 Oct;104(8):1150-5.

22.Asopa HS, Garg M, Singhal GG, Singh L, Asopa J, Nischal A. Dorsal free graft urethroplasty for urethral stricture by ventral sagittal urethrotomy approach. Urology. 2001 Nov 1;58(5):657-9.

23. Andrich DE, Mundy AR. Non-transecting anastomotic bulbar urethroplasty: a preliminary report. BJU international. 2012 Apr 1;109(7):1090-4.

24. Guralnick ML, Webster GD. The augmented anastomotic urethroplasty: indications and outcome in 29 patients. The Journal of urology. 2001 May 1;165(5):1496-501.

25. Kulkarni SB, Joshi PM, Venkatesan K. Management of panurethral stricture disease in India. The Journal of urology. 2012 Sep 1;188(3):824-30.

26. Spencer J, Blakely S, Daugherty M, Angulo JC, Martins F, Venkatesan K, Nikolavsky D. Clinical and patient-reported outcomes of 1-sided anterior urethroplasty for long-segment or panurethral strictures. Urology. 2018 Jan 1;111:208-13.

27. Angulo JC, Arance I, Esquinas C, Nikolavsky D, Martins N, Martins F. Tratamiento de la estenosis larga de uretra anterior asociada a liquen escleroso. Actas Urológicas Españolas. 2017 Mar 1;41(2):123-31.

28. Xu YM, Feng C, Sa YL, Fu Q, Zhang J, Xie H. Outcome of 1-stage urethroplasty using oral mucosal grafts for the treatment of urethral strictures associated with genital lichen sclerosus. Urology. 2014 Jan 1;83(1):232-6.

29. Barbagli G, Guazzoni G, Palminteri E, Lazzeri M. Anastomotic fibrous ring as cause of stricture recurrence after bulbar onlay graft urethroplasty. The Journal of urology. 2006 Aug 1;176(2):614-9.

30. Dutkiewicz SA, Wroblewski M. Comparison of treatment results between holmium laser endourethrotomy and optical internal

urethrotomy for urethral stricture. International urology and nephrology. 2012 Jun 1;44(3):717-24.

31. Atak M, Tokgöz H, Akduman B, Erol B, Dönmez İ, Hancı V, Türksoy Ö, Mungan NA. Low-power holmium: YAG laser urethrotomy for urethral stricture disease: comparison of outcomes with the cold-knife technique. The Kaohsiung journal of medical sciences. 2011 Nov 1;27(11):503-7.

32. Albers P, Fichtner J, Bruhl P, Muller SC. Long-term results of internal urethrotomy. The Journal of urology. 1996 Nov 1;156(5):1611-4.

33. Mazdak H, Meshki I, Ghassami F. Effect of mitomycin C on anterior urethral stricture recurrence after internal urethrotomy. European urology. 2007 Apr 1;51(4):1089-92.

34. Mundy AR. Adjuncts to visual internal urethrotomy to reduce the recurrence rate of anterior urethral strictures. European urology. 2007 Jun 1;51(6):1467-8.

35. Mazdak H, Izadpanahi MH, Ghalamkari A, Kabiri M, Khorrami MH, Nouri-Mahdavi K, Alizadeh F, Zargham M, Tadayyon F, Mohammadi A, Yazdani M. Internal urethrotomy and intraurethral submucosal injection of triamcinolone in short bulbar urethral strictures. International urology and nephrology. 2010 Sep 1;42(3):565-8.

36. Ivaz SL, Veeratterapillay R, Jackson MJ, Harding CK, Dorkin TJ, Andrich DE, Mundy AR. Intermittent self-dilatation for urethral stricture disease in males: A systematic review and meta-analysis. Neurourology and urodynamics. 2016 Sep;35(7):759-63.

37. Merrick GS, Butler WM, Wallner KE, Galbreath RW, Anderson RL, Allen ZA, Adamovich E. Risk factors for the development of prostate brachytherapy related urethral strictures. The Journal of urology. 2006 Apr 1;175(4):1376-81.

38. Sullivan L, Williams SG, Tai KH, Foroudi F, Cleeve L, Duchesne GM. Urethral stricture following high dose rate brachytherapy for prostate cancer. Radiotherapy and Oncology. 2009 May 1;91(2):232-6.

39. Ramchandani P, Banner MP, Berlin JW, Dannenbaum MS, Wein AJ. Vesicourethral anastomotic strictures after radical prostatectomy: efficacy of transurethral balloon dilation. Radiology. 1994 Nov;193(2):345-9.

40. Park R, Martin S, Goldberg JD, Lepor H. Anastomotic strictures following radical prostatectomy: insights into incidence, effectiveness of intervention, effect on continence, and factors predisposing to occurrence. Urology. 2001 Apr 1;57(4):742-6.

41. Sikafi Z, Butler MR, Lane V, O'flynn JD, Fitzpatrick JM. Bladder neck contracture following prostatectomy. British journal of urology. 1985 Jun;57(3):308-10.

42. Wettlaufer JN, Kronmiller P. The management of post-prostatectomy vesical neck contracture. The Journal of urology. 1976 Oct 1;116(4):482-3.

43. Surya BV, Provet J, Johanson KE, Brown J. Anastomotic strictures following radical prostatectomy: risk factors and management. The Journal of urology. 1990 Apr 1;143(4):755-8.

44. Popken G, Sommerkamp H, Schultze-Seemann W, Wetterauer U, Katzenwadel A. Anastomotic stricture after radical prostatectomy. European urology. 1998;33(4):382-6.

45. Eltahawy E, Gur U, Virasoro R, Schlossberg SM, Jordan GH. Management of recurrent anastomotic stenosis following radical prostatectomy using holmium laser and steroid injection. BJU international. 2008 Oct;102(7):796-8.

46. Vanni A, Zinman L, Buckley J. 1095 MANAGEMENT OF RECURRENT BLADDER NECK CONTRACTURES WITH URETHROTOMY AND MITOMYCIN C. The Journal of Urology. 2010 Apr 1;183(4):e426.

47. Wessells H, Morey AF, McANINCH JW. Obliterative vesicourethral strictures following radical prostatectomy for prostate cancer: reconstructive armamentarium. The Journal of urology. 1998 Oct 1;160(4):1373-5.

48. Granieri MA, Weinberg AC, Sun JY, Stifleman M, Zhao L. Robotic YV Plasty for Recalcitrant Bladder Neck Contracture. Urology. 2018 May 2.

49. Reiss CP, Rosenbaum CM, Becker A, Schriefer P, Ludwig TA, Engel O, Riechardt S, Fisch M, Dahlem R. The T-plasty: a modified YV-plasty

for highly recurrent bladder neck contracture after transurethral surgery for benign hyperplasia of the prostate: clinical outcome and patient satisfaction. World journal of urology. 2016 Oct 1;34(10):1437-42.

50. Šimunić V, Banović I, Ciglar S, Jeren L, Pavičić Baldani D, Šprem M. Local estrogen treatment in patients with urogenital symptoms. International Journal of Gynecology & Obstetrics. 2003 Aug;82(2):187-97.

51. Sussman RD, Hill FC, Koch GE, Patel V, Venkatesan K. Novel pericatheter retrograde urethrogram technique is a viable method for postoperative urethroplasty imaging. International urology and nephrology. 2017 Dec 1;49(12):2157-65.

52. Haider A, Mahmud SM. Pericatheter urethrogram after anastomotic urethroplasty: Is it a must?. Pakistan journal of medical sciences. 2018 Sep;34(5):1191.

53. Akhtar A, Khattar N, Goel H, Rao S, Tanwar R, Sood R. Looking beyond oral mucosa: Initial results of everted saphenous vein graft urethroplasty (eSVGU) in long anterior urethral strictures. Arab journal of urology. 2017 Sep 1;15(3):228-35.

54. Sinha RJ, Singh V, Sankhwar SN. Does tobacco consumption influence outcome of oral mucosa graft urethroplasty?. Urology journal. 2010;7(1):45-50.

55. Mathur RK, Sharma AK, Odiya S. Tunica albuginea urethroplasty for anterior urethral strictures: a urethroscopic analysis. International journal of Urology. 2009 Sep;16(9):751-5.