ANTERIOR URETHRAL STRICTURES: Basics, Nomenclature and Follow-up

Steven B. Brandes, MD, FACS
Stenosis vs Stricture

- **Stenosis** = Urethral Lumen narrowing noted on flexible cystoscopy or urethrography
- **Stricture** = Scar of urethral epithelium with varying degrees of corpus spongiosal fibrosis
- Contracts in 2 directions (lumen size and length)
Urethral Stenosis

- Two different sub-types
  - Short and Focal
  - Etiology: Instrumentation Trauma
  - Long and multiple
  - Etiology: Inflammation Infection
    (Urethritis, Littritis, LSA)

- 1. Urethral Stricture

- 2. Urethral Stricture Disease
Stricture Etiology

- Idiopathic 33%
- Iatrogenic 33%
- Traumatic 19%
- Inflammatory 15%

<table>
<thead>
<tr>
<th>Investigator</th>
<th>Stricture (n)</th>
<th>Idiopathic</th>
<th>Iatrogenic</th>
<th>Inflammatory</th>
<th>Traumatic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wesselle and McAninch</td>
<td>40</td>
<td>5</td>
<td>12</td>
<td>13</td>
<td>10</td>
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<tr>
<td>Wesselle et al.</td>
<td>25</td>
<td>0</td>
<td>11</td>
<td>9</td>
<td>5</td>
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<tr>
<td>Andrich and Mundy</td>
<td>83</td>
<td>35</td>
<td>38</td>
<td>7</td>
<td>1</td>
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<tr>
<td>Santucci et al.</td>
<td>168</td>
<td>64</td>
<td>24</td>
<td>12</td>
<td>68</td>
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<tr>
<td>Elliot et al.</td>
<td>60</td>
<td>37</td>
<td>9</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Andrich et al.</td>
<td>162</td>
<td>38</td>
<td>84</td>
<td>23</td>
<td>17</td>
</tr>
<tr>
<td>Featon et al.</td>
<td>194</td>
<td>65</td>
<td>63</td>
<td>38</td>
<td>28</td>
</tr>
<tr>
<td>Total (%); included only bulbar strictures</td>
<td>732</td>
<td>244 (33)</td>
<td>241 (33)</td>
<td>109 (15)</td>
<td>136 (19)</td>
</tr>
</tbody>
</table>
Stricture Grading:
Degree of Spongiofibrosis

Devine 1983
Classification by US

McAninch, 1988
Stricture Evaluation: Location, Length and Number

- Cytoscopy – flexible (adult, 16Fr.)
- Cystoscopy – flexible (pediatric)
- Urethrography (Gold Standard)
- Bouginage
- US
- MR
Complex proximal bulbar stricture

RUG

US
Penile urethral stricture

VCUG

Cystoscopy
<table>
<thead>
<tr>
<th>RUG</th>
<th>US - longitudinal</th>
<th>US- sagittal</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 cm bulbar stricture</td>
<td></td>
<td></td>
</tr>
<tr>
<td>annular bulbar stricture</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **RUG**
  - 3 cm bulbar stricture
  - Annular bulbar stricture

- **US - longitudinal**
  - Images of bulbar strictures in longitudinal view

- **US- sagittal**
  - Images of bulbar strictures in sagittal view
When is a Stenosis Significant?

- Symptomatic when lumen < 14 Fr.
- IPSS and Flow-rate as surrogates for invasive testing
  - IPSS >10, Q max < 15 ml/sec
  - 93% sensitive, 68% specific for a significant stricture

Urethral Diameter vs. IPSS


Urethral Diameter vs. Flow Rate
Normal vs. Stricture flow-rate
Flow Rate vs. IPSS

IPPS and Flow-rate:
Surrogates to Determine Urethroplasty Success

Treatment decision making

- Length
- Location
- Etiology
- Number
- Spongiofibrosis degree
- Prior procedures
- Co-morbid conditions
- Shared decision making
### Contemporary Treatment Options

<table>
<thead>
<tr>
<th>MIS</th>
<th>Open Surgery</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Urethral Dilation</td>
<td>• Excision and primary anastomosis (EPA)</td>
</tr>
<tr>
<td>• Optical Urethrotomy</td>
<td>• BMG or Skin graft</td>
</tr>
<tr>
<td>[+/− biological modifier]</td>
<td>• Penile skin island flap</td>
</tr>
<tr>
<td>• Endourethral Prosthesis</td>
<td>• Combined tissue transfer</td>
</tr>
<tr>
<td></td>
<td>• Staged repair</td>
</tr>
<tr>
<td></td>
<td>• Perineal urethrostomy</td>
</tr>
</tbody>
</table>
Optical Urethrotomy

• Readily available, minimal invasive, technically easy = Popular
• Goal:
  – Epithelial re-growth before scar re-appoximation
  – Scar remodeling to a fixed open position
• Limited potential for a cure

## Urethrotomy: Complications

<table>
<thead>
<tr>
<th>Author(s)</th>
<th>Complication</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quint, Stanisic (1993)</td>
<td>Hemorrhage</td>
<td>20%</td>
</tr>
<tr>
<td>Giannakopolous et al (1997)</td>
<td>Perineal hematoma</td>
<td>20%</td>
</tr>
<tr>
<td>Giannkopolous et al (1997)</td>
<td>Scrotal edema</td>
<td>13.4%</td>
</tr>
<tr>
<td>Boccon-Gibod, Le Portz (1982)</td>
<td>False passage</td>
<td>10%</td>
</tr>
<tr>
<td>Quint, Stanisic (1993)</td>
<td>Rectal perforation</td>
<td>10%</td>
</tr>
<tr>
<td>Giannakopolous et al (1997)</td>
<td>Epididymo-orchitis</td>
<td>8.8%</td>
</tr>
<tr>
<td>Giannakopolous et al (1997)</td>
<td>Meatal stenosis</td>
<td>8.8%</td>
</tr>
<tr>
<td>Shawky (1995)</td>
<td>Urinary incontinence</td>
<td>8.7%</td>
</tr>
<tr>
<td>Kinder, Rous (1979)</td>
<td>Fever</td>
<td>3.6%</td>
</tr>
</tbody>
</table>
Urethrotomy Lacks Efficacy

  – Prospective RCT: Italian Study
  – 58% recurrence at 5 yrs. after 1\textsuperscript{st} OIU
  – 100% recurrence after 2\textsuperscript{nd} or 3\textsuperscript{rd} OIU

  – Prospective RCT: South African Study
  – 39% recurrence at 48 months after 1\textsuperscript{st} OIU
  – 100% recurrence after 2\textsuperscript{nd} by 44 mo
  – 100% recurrence after 3\textsuperscript{rd} by 18 mo.

Similar Futility
Urethrotomy is Temporizing

DVIU + biologic modifiers

- Steroids
  - Longer time to recurrence
  - Restenosis rates unchanged

- MMC
  - Promising results
  - Jury still out

- AmnioFix
  (amnion- chorion = rich in GF)
  - (?)
Recurrence after OIU or Dilation


Peak at 6mo.
Urethrotomy success and stricture etiology

Non-trauma 66%

Pansadoro V. and Emiliozzi P, J Urol 1996; 156:73-75

Trauma 16%
Radiation Etiology Effects OIU Success

- 68 pts. -- 46 EBRT, 22 BT
- Mean age 66
- BT mean survival 3.7 mo., stricture length 2.4 cm
- EBRT mean survival 26.3 mo., stricture length 2.3 cm

Thom M, Brandes SB: AUA Sectional Meeting, 2009
Stricture location effects
Urethrotomy success

penile urethra 16%

bulbar urethra 42%

Pansadoro V. and Emiliozzi P, J Urol 1996; 156:73-75
Stricture Length determines Urethrotomy Success

Heyns CF et al: Treatment of male urethral strictures: is repeated dilation or internal urethrotomy useful? J Urol 160 356-358
Urethrotomy and Dilation have Similar Outcomes

Follow up (Months)

Stricture-free Rate

A = OIU
B = Dilation

P = 0.22

Successive urethrotomy negatively impacts urethroplasty success

- Singh et al: Urology 75:179-182, 2010
Urethroplasty is Cost Effective

  - Cost minimization decision analysis model
- Wright JL et al: Urology 67, 889 2006 (Seattle)
  - Cost effectiveness model for bulbar strictures < 2cm
  - Mean FU - 25 mo., short bulbar strictures

CONCLUSIONS:

Most cost effective: < 2cm = 1 OIU prior to urethroplasty
> 2cm = Urethroplasty
MIS Summary

- Dilation and DVIU have similar efficacy
- Long Term Outcomes are Poor
- Not cost effective
- Successive Urethrotomy negatively impacts urethroplasty complexity and success
- Limit to bulbar strictures < 2cm x 1
Are Urethral Stents the future of Urethral Stenosis Management?

- Permanent
- Retrievable
- Bio-absorbable
- Drug eluting

Uro-coil  Allium  Allium  PLA

Memokath
Anastomotic Urethroplasty

- EPA = “urethral flap surgery” that relies on bipedal corpus spongiososal circulation
- Detached from its proximal vascular supply: urethra is dependent on retrograde blood flow
Methods to Bridge the Gap in Anastomotic Urethroplasty

• Natural elasticity of the mobilized corpus spongiosum

• Shorten the distance between the urethra ends

“The shortest distance between 2 points is a straight line”.
## EPA Long-term Results

<table>
<thead>
<tr>
<th>Author</th>
<th>No. patients</th>
<th>Avg. length</th>
<th>% Success</th>
<th>Follow-up</th>
</tr>
</thead>
<tbody>
<tr>
<td>El tahawy et al. (33)</td>
<td>213</td>
<td>1.9 cm</td>
<td>98.5</td>
<td>40.5 mo</td>
</tr>
<tr>
<td>Santucci et al. (9)</td>
<td>168</td>
<td>1.7 cm</td>
<td>95.2</td>
<td>72 mo</td>
</tr>
<tr>
<td>Andrich et al. (23)</td>
<td>82</td>
<td>-</td>
<td>86</td>
<td>180 mo</td>
</tr>
<tr>
<td>Micheli et al. (6)</td>
<td>71</td>
<td>0.5–3 cm</td>
<td>93</td>
<td>60 mo</td>
</tr>
<tr>
<td>Martinez-Piñeiro et al. (26)</td>
<td>69</td>
<td>&lt;3 cm</td>
<td>88</td>
<td>44.4 mo</td>
</tr>
<tr>
<td>Jakse et al. (27)</td>
<td>60</td>
<td>1–4 cm</td>
<td>93.3</td>
<td>45 mo</td>
</tr>
<tr>
<td>Lindell et al. (35)</td>
<td>49</td>
<td>&lt;2.5 cm</td>
<td>95.9</td>
<td>12–48 mo</td>
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<tr>
<td>Panagakis et al. (36)</td>
<td>42</td>
<td>&lt;2 cm</td>
<td>95.2</td>
<td>3–72 mo</td>
</tr>
<tr>
<td>Kessler et al. (24)</td>
<td>40</td>
<td>-</td>
<td>86</td>
<td>72 mo</td>
</tr>
<tr>
<td>Barbagli et al. (34)</td>
<td>20</td>
<td>&lt;2 cm</td>
<td>95</td>
<td>54.5 mo</td>
</tr>
<tr>
<td>Total</td>
<td>814</td>
<td></td>
<td>93</td>
<td></td>
</tr>
</tbody>
</table>

**Summary:** 86-95% success at 5 yrs. 86% success at 15 yrs.
Substitution Urethroplasty

• Graft:
  – Tissue transfer dependent on host bed for blood supply and nutrients. No vascular pedicle.
  – Graft success = “% Take”

• Flap:
  – Tissue transfer with donor site blood supply intact.
  – Flap Success = “Survival”
Oral Graft Urethroplasty Options

Ventral Graft

Dorsal Graft

Graft inlay

Inlay + BMG
## Ventral vs. Dorsal BMG


<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Success</th>
<th>FU (mean)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ventral BMG</td>
<td>248</td>
<td>84%</td>
<td>37 mo.</td>
</tr>
<tr>
<td>Dorsal BMG</td>
<td>178</td>
<td>88%</td>
<td>36 mo.</td>
</tr>
</tbody>
</table>

$P > 0.05$ = Ventral and Dorsal BMG placement have equivalent success
Penile Invagination and Perineal Incision for Dorsal BMG Urethroplasty

Bulbar urethra exposed
Penile Invagination
Penis invaginated under scrotum

Images: S Kulkari
Penile urethroplasty via perineal incision

One sided urethral dissection

Dorsal urethrotomy

Dorsal BMG quilted
Penile urethroplasty via perineal incision

Advantages

• Penile Cosmesis
• One stage repair
• BMG-best urethral substitute
• Dorsal - No diverticulum
• Preserve neuro-vascular supply to the urethra on one side
Circular Penile Skin Flap:
[Quartey, McAninch]

15cm
Circular Penile Skin Flap
Orandi Flap (Longitudinal penile skin)
Current controversies in anterior urethral stricture repair: free-graft versus pedicled skin-flap reconstruction.

- Meta-analysis of 26 surgical series

<table>
<thead>
<tr>
<th></th>
<th>Recurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Free Grafts</td>
<td>15.7%</td>
</tr>
<tr>
<td>Skin Pedicle Flaps</td>
<td>14.1%</td>
</tr>
</tbody>
</table>

P > 0.05

= Equivalent Success

Dorsal Onlay Buccal Mucosa Versus Penile Skin Flap Urethroplasty for Anterior Urethral Strictures: Results From a Randomized Prospective Trial
Deepak Dubey,* Vivek Vijjan, Rakesh Kapoor, Aneesh Srivastava, Anil Mandhani, Anant Kumar and M. S. Ansari
From the Department of Urology, Sanjay Gandhi Postgraduate Institute of Medical Sciences, Lucknow, India

THE JOURNAL OF UROLOGY®
Vol. 178, 2466-2469, December 2007
Penile Skin Flap Complications

- Skin necrosis and granulation
- Skin necrosis
- Penile torsion
- Skin and flap necrosis
- Fistula
- Diverticulum
Substitution Urethroplasty – Long-term and Progressive Failures

<table>
<thead>
<tr>
<th></th>
<th>1 yr</th>
<th>5 yr</th>
<th>10 yr</th>
<th>15 yr</th>
</tr>
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<tbody>
<tr>
<td>Anastomotic</td>
<td>7%</td>
<td>12%</td>
<td>13%</td>
<td>14%</td>
</tr>
<tr>
<td>Substitution</td>
<td>12%</td>
<td>21%</td>
<td>30%</td>
<td>42%</td>
</tr>
</tbody>
</table>

1st yr. (10-12%) – After, 2% annual re-stricture rate

Substitution Urethroplasty: Long-term Failures

Whitson JM: J Urol 179: 2259-2264, 2008 (San Fran)

<table>
<thead>
<tr>
<th></th>
<th>1 yr.</th>
<th>3 yr.</th>
<th>5 yr.</th>
<th>10 yr.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Failure</td>
<td>20%</td>
<td>28%</td>
<td>33%</td>
<td>39%</td>
</tr>
<tr>
<td>After OIU</td>
<td>5%</td>
<td>11%</td>
<td>16%</td>
<td>21%</td>
</tr>
</tbody>
</table>

N = 124, Median FU- 7.3 yrs.
Staged Urethroplasty with STSG
Staged urethroplasty with BMG
Follow-up after Urethroplasty

- Anastomotic - 5 years
- Substitution – yearly, no clear limit
- RUG and VCUG = gold standard
- IPSS and flow rate = reasonable surrogates to invasive testing
Definition of Urethroplasty Failure

- Need for 2nd procedure: 60.0%
- Significant narrowing on RUG: 14.4%
- Narrowing that prevents passage of 16F flexible cystoscope: 12.2%
- Voiding dysfunction as shown by poor uroflow or AUASS: 7.8%

Methods to Screen for Stricture Recurrence

- Uroflowmetry: 85.4%
- Post-void residual: 56.2%
- AUASS: 41.6%
- Urinalysis: 38.2%
- Flexible cystoscopy: 19.1%
- Retrograde urethrogram: 16.9%

Yeung LL et al: GURS Survey, Urology 2013
Differing Definitions of Re-Stricture Effects Urethroplasty “Success”

Elliot et al: J Urol, 2013
Follow-up Survey Conclusions

• There is no consensus or standard evaluation for follow-up after urethroplasty

• Need a standardized definition of urethroplasty failure and follow-up protocols
Conclusions

- Urethral stricture is an **open** surgical disease
- No single type of repair is suitable for all strictures.
- Urethral reconstruction must be individualized.
- Urethroplasty results are effective and durable
Thank you