Journal of Population Therapeutics & Clinical Pharmacology

RESEARCH ARTICLE
DOI: 10.53555/w8wxch98

# RETROGRADE URETHROGRAPHY AND MAGNETIC RESONANCE URETHROGRAPHY IN THE ASSESSMENT OF MALE URETHRAL STRICTURE DISEASE: A CROSS-SECTIONAL DIAGNOSTIC STUDY

**Dr. A. E. Poornima[1], Dr. D. Tamilselvan[2]*, Dr S. Balasiddharth[3], Dr. C. Sabarigirinathan[4], Dr. Dinesh Venkatesan[5]**

[1] Assistant Professor, Department of General Surgery, ESIC Medical College, K.K.Nagar, Chennai 600078, Tamil Nadu, India
[2]*Assistant Professor, Department of Urology, Kilpauk Medical College, Chennai 600010, Tamil Nadu, India
[3]Department of Pharmacology, M.K.C.G Medical College, Berhampur, Odisha - 760 004, India
[4] Professor and Vice Principal, Govt. Dental College, Chennai, Tamil Nadu, India
[5] Private Practitioner, Chengalpattu, Tamil Nadu, India

***Corresponding Author:** Dr. D. Tamilselvan
*E-mail: drtselvan@gmail.com

**Abstract:**

**Background:** Male urethral stricture is a prevalent urological disorder with considerable morbidity. Effective imaging is of paramount importance in both diagnosis and surgical planning. Retrograde Urethrography (RUG) remains the standard imaging technique, while Magnetic Resonance Urethrography (MRU) provides a non-invasive alternative with precise anatomical assessment.

**Objective:** To compare the clinical usefulness of Retrograde Urethrography and Magnetic Resonance Urethrography in the assessment of male urethral stricture disease, with special reference to their value in surgical planning.

**Materials and Methods:** In this prospective cross-sectional diagnostic study, 30 male patients (mean age 42.7 ± SD) clinically suspected of urethral stricture at Kilpauk Medical College and Government Rajaji Hospital (April 2012–February 2013) underwent RUG followed by contrast-enhanced MRU. Inclusion criteria comprised all adult males with suspected urethral stricture; exclusions included acute urethritis, prior urethroplasty or internal urethrotomy, MRI contraindications, or pelvic floor distraction defects. Imaging findings (site, number, length of strictures, spongiofibrosis, associated pathology, and prostatic displacement) were correlated with endoscopic or surgical findings. Mean stricture lengths and diagnostic accuracy—including sensitivity, specificity, predictive values, and kappa agreement—were calculated. Paired t-tests and correlation analyses assessed measurement concordance between RUG/MRU and surgical findings.

**Results:** Thirty patients (24 anterior, 6 posterior strictures) were included. Mean overall stricture lengths determined by RUG, MRU, and surgery were 1.72 cm, 1.56 cm, and 1.56 cm, respectively. In anterior strictures, MRU measurements (1.36 cm) correlated more closely with surgical length (1.29 cm; r=0.833) than RUG (1.19 cm; r=0.530). In posterior strictures, MRU (2.55 cm; r=0.924) matched surgical findings (2.50 cm) more accurately than RUG (4.08 cm; r=0.491). Overall diagnostic accuracy for predicting surgery type reached 90.1% for MRU versus 83.3% for RUG.

RUG demonstrated 80% sensitivity and 85% specificity, with a kappa of 0.634 for length-based surgical planning.
**Conclusion:** MR urethrography is a superior non-invasive modality compared to RUG for assessing male urethral stricture, particularly regarding accurate stricture length, evaluation of spongiofibrosis, and delineation of posterior distraction defects, thereby enhancing preoperative planning.

**Keywords:** Male urethral stricture, Retrograde Urethrography (RUG), Magnetic Resonance Urethrography (MRU), Diagnostic imaging

## Introduction:

Male urethral stricture is a common urologic condition defined by lumen narrowing of the urethra by fibrosis after trauma, inflammation, or iatrogenic damage. Obstructive lower urinary tract symptoms (LUTS), urinary infections, or acute retention are typical presenting symptoms. Strictures are most often divided into anterior (inflammatory or iatrogenic) and posterior (post-traumatic bulbomembranous distraction defect).
Imaging is an essential component of diagnosis and treatment planning. Retrograde Urethrography (RUG) has long been held to be the gold standard for its availability and economics. Despite this, RUG also has several disadvantages, such as underestimation of stricture length and failure to visualize periurethral spongiofibrosis or contiguous soft tissue pathology.
Conversely, Magnetic Resonance Urethrography (MRU) offers multiplanar, high-resolution soft tissue imaging with no exposure to ionizing radiation or contrast-related adverse effects. MRU has been promising in reproducibly delineating stricture length, location, and related pathologies such as fistulas, abscesses, or periurethral fibrosis.
This study intends to evaluate and compare diagnostic performance of RUG and MRU for male urethral strictures, especially for surgical planning.

## Background:

Several studies have assessed the diagnostic utility of RUG and MRU:
DE Andrich and A.R. Mundy delineated stricture as a scarring resulting from infection or trauma, causing narrowing. Cunningham (1910) set RUG as the gold standard modality for imaging of the urethra. Gallentine and Morey emphasized RUG's insufficiency in posterior urethral assessment, particularly in the absence of adjunctive voiding cystourethrography (VCUG). Mahmud et al. noted 91% sensitivity and 72% specificity for RUG, and 100% sensitivity for MRU. Oh et al. concluded that MRU was better for assessing obliterative posterior strictures. El-Ghar et al. illustrated MRU's greater accuracy in diagnosis, particularly in the identification of associated complications and in stricture length estimation. Osman Y reported MRU identified additional pathology not identified on RUG, including spongiofibrosis and urethro-rectal fistulas. Narumi Y illustrated MRU yielded critical information regarding prostatic displacement and urethral defect length in trauma. Other research validated MRU's advantage in periurethral pathology, spongiofibrosis, and precise stricture demarcation detection compared to conventional imaging. These results support the progressive role of MRU in global urethral assessment.

## Materials and Methods:

Study Design: A Prospective, Comparative Cross-Sectional Diagnostic study.
Study Setting: This study was conducted in the Department of Urology at Kilpauk Medical College and Government Rajaji Hospital (GRH), Tamil Nadu.
Study Period: April 2012 – February 2013.
Sample Size: 30 male patients who were clinically suspected of having a urethral stricture.
**Inclusion Criteria:** All male patients clinically suspected to have urethral stricture disease.

**Exclusion Criteria:** Acute urethritis, History of past optical internal urethrotomy, History of past urethroplasty, Patients with metallic implants or cardiac pacemakers, Strictures related to urethral and pelvic floor distraction defects (PFUDD) in patients with contraindications to MRI

**Imaging Parameters:**

**Retrograde Urethrography (RUG):**

Patient placed in 45° oblique supine position. 20 ml of 60% lohexol contrast mixed with saline was injected via a syringe and cannula into the urethral meatus. X-rays were obtained during and after contrast administration. For distraction defects of the posterior urethra, RUG was augmented with opposing urethrography by antegrade contrast via suprapubic catheter during voiding.

**Magnetic Resonance Urethrography (MRU):**

Supine position, bladder full of 150–300 ml saline. 10 ml of sterile jelly was put in the urethra and maintained with gauze tied at glans. T1- and T2-weighted MRI sequences were acquired before and 3 minutes after intravenous injection of gadopentetate dimeglumine contrast. Imaging was performed in axial, coronal, and sagittal planes to assess stricture morphology and soft tissue around.

**Evaluation Parameters:**

Findings on imaging were correlated with endoscopic or surgical findings. The following parameters were evaluated: Stricture site, Number of strictures, Stricture length (measured along the long axis in sagittal plane), Degree of spongiofibrosis (low T2 signal), Associated pathology (e.g., fistulas, periurethral abscess, soft tissue fibrosis), Prostatic displacement in strictures posterior (sagittal and coronal MR images measured).

**Results:**

Out of the 30 total participants, 10 cases were Poat-Inflammatory, 14 were post-instrumentation and 6 were Post-Traumatic Distraction defects. In the total 30 cases, most of them were above 40 years old (46.7 %). (Table 1) The mean age was 42.7 years.

| Characteristics of Participants | | | |
|---|---|---|---|
| Post Inflammatory Patients | 10 | | |
| Post Instrumentation Patients | 14 | | |
| Post Traumatic Distraction Defects | 6 | | |
| Age Distribution | | | |
| | Anterior Urethra | Posterior Urethra | Total |
| 20 - 30 years | 2 | 3 | 5 |
| 30 - 40 years | 10 | 1 | 11 |
| 40-60 years | 12 | 2 | 14 |
| Total | 24 | 6 | 30 |

**Table 1: Participant Characteristics and Age Distribution**.

The findings of Retrograde Urethropathy and Magnetic Resonance Urethropathy are tabulated in Table 2.

| Retrograde Urethropathy | | | |
|---|---|---|---|
| Site of Stricture | Anterior Urethra | Posterior Urethra | Total |
| Blind End Bulbar Urethra | 0 | 6 | 6 |
| Distal Bulbar | 16 | 0 | 16 |
| Long Bulbar | 1 | 0 | 1 |
| Proximal Bulbar | 7 | 0 | 7 |
| Retrograde Urethropathy | | | |
| Length of Stricture | Anterior Urethra | Posterior Urethra | Total |
| Less than 1.5 cm | 19 | 0 | 19 |
| More than 1.5 cm | 5 | 6 | 11 |
| Total | 24 | 6 | 30 |
| Magnetic Resonance Urethropathy | | | |
| MRU Length | Anterior Urethra | Posterior Urethra | Total |
| Less than 1.5 cm | 16 | 0 | 16 |
| More than 1.5 cm | 8 | 6 | 14 |
| Total | 24 | 6 | 30 |
| Magnetic Resonance Urethropathy | | | |
| Site of Stricture | Anterior Urethra | Posterior Urethra | Total |
| Bulbomembranous | 0 | 6 | 6 |
| Distal Bulbar | 14 | 0 | 14 |
| Long Bulbar | 3 | 0 | 3 |
| Proximal Bulbar | 7 | 0 | 7 |
| Magnetic Resonance Urethropathy | | | |
| Other Findings | Anterior Urethra | Posterior Urethra | Total |
| Nil | 20 | 0 | 20 |
| Spongiofibrosis, Periurethral Fibrosis, Prostatic Apex Displacement | 4 | 6 | 10 |

**Table 2: Retrograde Urethropathy and Magnetic Resonance Urethropathy Findings**

Among the 24 anterior urethral stricture, endoscopic procedure (VIU) was done for 20 patients. In these 20 cases, one case showed only mild narrowing and the scope passed with little negotiation. In another case showed mild catching of bulbar urethra with mild bladder neck elevation, for which bladder neck incision was done. 4 cases of stricture of anterior urethra (2cases <1.5cm & 2cases >1.5cm) was managed by open repair (3 augmentation urethroplasty, lanastomotic urethroplasty) 6 PFUDD cases were managed by progressive perineal anastomotic urethroplasty.

During the procedure the findings noted are, 2 cases showed mild narrowing & unhealthy penile urethra, 1 case had mild meatal stenosis, 4 cases showed thick fibrosed urethra (spongiofibrosis), 6 cases had obliterated bulbar urethra with periurethral fibrosis, 1 case had mild catch in the bulbar urethra and mild bladder neck elevation and 16 cases did not exhibit any associated findings other than stricture. (Table 3)

| Surgical Findings - Length | | | |
|---|---|---|---|
| Surgery - Length of Stricture | Anterior Urethra | Posterior Urethra | Total |
| Less than 1.5 cm | 20 | 0 | 20 |
| More than 1.5 cm | 4 | 6 | 10 |
| No Stricture, BNE + Mild catching in Bulbar Urethra | 1 | 0 | 1 |
| Surgical Findings - Site | | | |
| Surgery - Site of Stricture | Anterior Urethra | Posterior Urethra | Total |
| Bulbomembranous | 0 | 6 | 6 |
| Distal Bulbar | 14 | 0 | 14 |
| Long Bulbar | 3 | 0 | 3 |
| Proximal Bulbar | 6 | 0 | 6 |
| No Stricture | 1 | 0 | 1 |
| Surgical Findings – Surgery Type | | | |
| Surgery Types | Anterior Urethra | Posterior Urethra | Total |
| Anastomic Urethroplasty | 1 | 6 | 7 |
| Augmentation Urethropathy | 3 | 0 | 3 |
| Milad Narrowing in the distal bulbar urethra scope passed with mild negotiation | 1 | 0 | 1 |
| No Stricture, BNI done, Mild Catching in bulbar urethra | 1 | 0 | 1 |
| OIU | 15 | 0 | 15 |
| OIU & Meatal Dilation | 1 | 0 | 1 |
| OIU & Guided Urethral Dilation | 2 | 0 | 2 |
| Total | 24 | 6 | 30 |

**Table 3: Surgical Findings (A) Length of the Stricture (B) Site of the Stricture (C) Surgery Type**

In the anterior urethra, the site of stricture in both RUG and MR urethrogram was well correlated with the site in surgery. In the posterior urethra, RUG showed only a blind ending bulbar urethra and a closed bladder neck, but MRU showed the exact site in all 6 cases. In all cases, both RUG and MRU showed a single stricture.

In overall 30 cases, the mean length of the stricture by RUG, MRU, and Surgery was 1.72 cm, 1.56 cm, and 1.56 cm, respectively. The mean length of stricture by RUG, MRU, and Surgery in anterior stricture cases was 1.19 cm ,1.36 cm, and 1.29 cm, respectively. The mean length of stricture by RUG, MRU, and Surgery in posterior distraction defect cases was 4.08cm, 2.51 cm, and 2.5 cm, respectively. (Table 4) (Chart 1)

| | N | Mean | Std. Deviation | Std. Error | 95% CI Upper Limit | 95% CI Lower Limit | Minimum Value | Maximum Value |
|---|---|---|---|---|---|---|---|---|
| Retrograde Urethropathy | 30 | 1.726 | 1.237 | 0.225 | 1.264 | 2.188 | 0.500 | 4.500 |
| Magnetic Resonance Urethropathy | 30 | 1.560 | 0.638 | 0.116 | 1.321 | 1.798 | 0.600 | 2.900 |
| Surgery | 28 | 1.560 | 0.650 | 0.122 | 1.308 | 1.812 | 0.600 | 3.000 |

**Table 4: Mean Length of the Stricture**

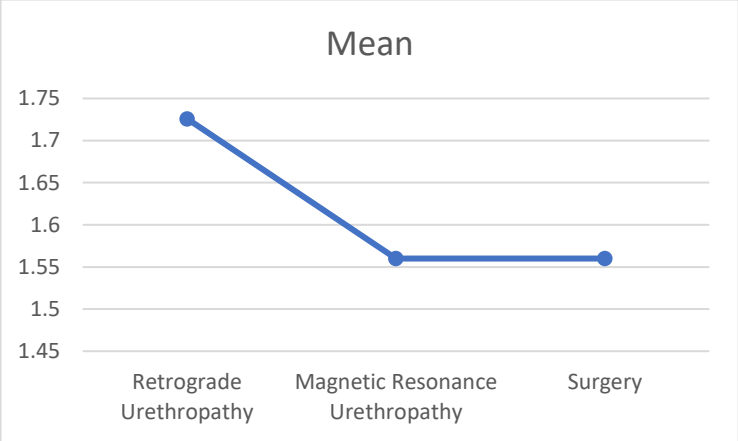


**Chart 1: Mean Length of the Stricture**

Among the surgical cases, Paired-T-Test (Table 5) and Correlation analysis (Table 6) were performed for the Anterior Stricture and Posterior Stricture separately.

| Paired t Test for Anterior Stricture | | | | |
|---|---|---|---|---|
| Pair | N | Mean | Std. Deviation | Std. Error |
| RUG Length & Surgery Length | 22 | 1.190 | 0.287 | 0.061 |
| | 22 | 1.304 | 0.446 | 0.095 |
| MRU Length& Surgery Length | 22 | 1.368 | 0.394 | 0.084 |
| | 22 | 1.304 | 0.446 | 0.095 |
| Paired t Test for Posterior Stricture | | | | |
| Pair | N | Mean | Std. Deviation | Std. Error |
| RUG Length & Surgery Length | 6 | 4.083 | 0.231 | 0.094 |
| | 6 | 2.500 | 0.316 | 0.129 |
| MRU Length & Surgery Length | 6 | 2.550 | 0.273 | 0.111 |
| | 6 | 2.500 | 0.316 | 0.129 |

**Table 5: Paired t Test for the length of the Anterior and Posterior Urethral Stricture**

| Correlation for Anterior Stricture | | | |
|---|---|---|---|
| Pair | N | Correlation | Significance |
| RUG Length & Surgery Length | 22 | 0.530 | 0.011 |
| MRU Length& Surgery Length | 22 | 0.833 | 0.000 |
| Paired t Test for Posterior Stricture | | | |
| Pair | N | Correlation | Significance |
| RUG Length & Surgery Length | 6 | 0.491 | 0.322 |
| MRU Length& Surgery Length | 6 | 0.924 | 0.000 |

**Table 5: Correlation for the length of the Anterior and Posterior Urethral Stricture**

Diagnostic Tests were performed between Retrograde Urethropathy and Surgery. The values are tabulated in a 2x2 table. Sensitivity of 80%, Specificity of 85%, Positive Predictive Value of 72.73%, and Negative Predictive Value of 89.47% were derived. The Kappa Measure of Agreement was found to be 0.634. (Table 6) Diagnostic Accuracy of RUG for predicting the type of surgery was found to be 83.33%

| Surgery Type / MRU Findings | Endo | Open Surgery | Total |
|---|---|---|---|
| Less than 1.5 cm | 17 | 2 | 19 |
| More than 1.5 cm | 3 | 8 | 11 |
| Total | 20 | 10 | 30 |

**Table 6: Diagnostic test Table between MRU Findings and Surgery Type**

**Discussion:**

Retrograde urethrogram was established as gold standard imaging method for the diagnosis of stricture urethra in 1910, by Cunningham[3] due to its wide availability and the simplicity of the technique. However, it has some limitations such as over or under estimation, effect of radiation and does not give information regarding spongiofibrosis.

To conquer this limitation, MRI was recommended, as per Garcia-Valtuille, treatment option C/I and mode of approach based on the site, spongiofibrosis and length, associated pathology. Stricture < 1.5 cm without spongiofibrosis can be repaired endoscopically. The long stricture > 1.5cm with spongiofibrosis is treated by open repair either anastomotic or augmentation urethroplasty 26 via perineal approach, but complicated stricture requires transpubic approach.

This research revealed the sensitivity & specificity of diagnosing stricture by RUG &MRU was 100% &93.4% both in posterior & anterior urethra. While in the research conducted by Syed Mamun Mahmud et al., sensitivity & specificity of RUG in the diagnosis of urethral stricture was 91% &72%, while by MRU it was 100%.

The other research by MA El-Ghar et al demonstrated the sensitivity, specificity in diagnosing anterior urethral stricture by RUG was 91% & 90% and 89% & 91.7% for posterior urethra, by MRU it was 91.7% (ant &post). In sonourethrography, the accuracy was 100% in the anterior urethra and 60% in the posterior urethra.

In this research, the accuracy demonstrated by RUG for surgical planning was 83% and by MR urethrogram was 90.1%. But in the research conducted by Yasser osman[1] accuracy for both RUG and MR urethrogram was 85%.

In this research, MR urethrogram correctly diagnosed all the cases of anterior and posterior stricture with precise delineation of its length with 100% sensitivity, 93.4% specificity and 90.1% overall accuracy, which was well correlated with the study of MA El-Ghar et al 13

In this research in 6 cases of posterior distraction defect, RUG revealed overestimation of

defect due to failure of relaxation of the bladder neck. But MR urethrogram revealed proper length and related findings, which helped plan the surgical procedure, like the study by Sung DJ et al.
In this limited series of patients, MR urethropathy was an encouraging method for the assessment of male urethral stricture. It had the strengths of RUG and sonourethrography and only a few drawbacks of cost-effectiveness and its availability.

**Conclusion:**
In summary, our study has demonstrated that MR urethrography is a very useful and promising non-invasive technique for the evaluation of male anterior urethral stricture and posterior urethral distraction defect for planning the surgical approach. It was superior than RUG for the accurate assessment of the length of stricture and extent of spongiofibrosis in anterior urethral stricture. In posterior urethral defect MR urethrography, it correctly estimates the length of the stricture, degree of prostatic displacement, and delineates the site & density of scar tissue, which helps to plan the surgical approach. This procedure is also well tolerated by patients who are allergic to iodinated contrast during RUG.

**References:**
1. Andrich DE, Mundy AR. Urethral strictures and their surgical management. BJU 2000, 86:571-580.
2. Nielsen, Nordling J.UROLOGY 1990, 35(1):18-24.
3. Cunninhaml. The diagnosis of stricture of the urethra by x-rays 1910, 5; 369-371.
4. GallentineML,MoreyAF.Imaging of the male urethra for stricture disease. Urolclin north Am 2002:29; 361-72
5. Nash PA,McAninchJW,BruceJE, HanksDK.Sono-urethrography in the evaluation of anterior urethral strictures J Urol. Jul;154(1):72-6
6. SyedMamun Mahmud et al- Is ascending urethrogram mandatory for all urethral strictures? Jan-Dec 2002.
7. FriedburgHG, WimmerB, HennigUrologe A.1987 Nov; 26(6):309-16
8. Garcia-Valtuille, F Aascal et al - The British Journal of Radiology, July 2006.
9. Oh MM, Jin MH, Sung DJ, Yoon DK, Kim JJ, Moon du G. Magnetic resonance urethrography to assess obliterative posterior urethral stricture: comparison to conventional retrograde urethrography with voiding cystourethrography. J Urol. 2010; 183(2):603-7.
10. J Eaton MS FRCS, J Richenberg et al-Imaging of urethra BJR 17, 139, 149, 2005
11. Jeong-ah Ryu Imaging of male and female urethra - Department of Radiology, Samsung medical centre.rsna.info/content/21/5/1169.
12. Moon-Hae Choi, MD, Bohyun Kim, Sung Won Lee MD- Department of Radiology and Urology, Samsung medical centre -September 2000, 135-710
13. MA El-Ghar Department of Radiology and Urology. Mansoura University, Egypt, EJR 2010 15 Jul 2009.
14. Y Osman-European Urology, MR-urethrography in comparison to retrograde Urethrography in Diagnosis of male urethral strictures 50/3,587-594, September 2006.
15. YNarumi -1993 MR imaging of traumatic posterior urethral injury.radiology.rsna.org/content/ 188/2/439.
16. DJ Sung et al. Obliterative Urethral Stricture: MR Urethrography verses Conventional Retrograde Urethrography with voiding Cystourethrography. Rsna 2006; 240(3):842-48.
17. Bircan MK, Sahin H, Korkmaz.K.IntUrol Nephrol. 1996; 28(6):801-4
18. Pavlica P, Barozzi L, Menchi I. EurRadiol. 2003 Jul; 13(7):1583-96. Epub 2002 Dec 19.
19. KoraitimMM,Reda IS- Role of MRI in assessment of posterior urethral distraction defects; J Urol 2007 Aug; 28(4):258-73.
20. Campbell-Walsh Urology:9th edi; voll; Urinary tract imaging 4:116-119
21. ChambersRM, Baitera B Anatomy of urethral stricture BJU 1977; 49; 545-551

22. Michael L. Gallentine AF - Imaging of male urethra, UCNA vol29; 2; 2002, 361-372.
23. Pollack.M, Bruce L.McClennan, clinicalurography, 2edi, voll; 8; 328-350
24. MoreyAF, McAninch JW Role of sonourethrography in bulbar urethral stricture. JUrol 1997; 158(4); 1376-1379.
25. Dixon CM. MR imaging of posterior urethral defect and pelvic injuries.JUrol 1992; 148; 1162-1165
26. PetersonAC, WebsterGD, Management of urethral stricture disease, BJU 2004; 94; 971-976.
27. Choudhary S, Singh Pet al, comparison of sonourethrography and retrograde urethrography in evaluation of anterior urethral strictures JRadio 2004 Aug;59(8):736-42.