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ORIGINAL ARTICLE

# The T-plasty as therapy for recurrent bladder neck stenosis: success rate, functional outcome, and patient satisfaction

**Clemens M. Rosenbaum[1] · Roland Dahlem[1] · Valentin Maurer[1] · Luis A. Kluth[1] · Malte W. Vetterlein[1] · Margit Fisch[1] · Victor Schuettfort[1] · C. Philip Reiss[1]**

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**Abstract**
*Purpose* To determine success rate (SR), functional outcome, and patient satisfaction of a modified YV-plasty for reconstruction of the bladder neck in case of recurrent bladder neck stenosis (BNS) after transurethral surgery of the prostate: the T-plasty.
*Patients and methods* We identified all patients who underwent T-plasty at our center between December 2008 and July 2016. Patients' charts were reviewed. Patients were queried by telephone and by mail at time of follow-up (FU). Primary endpoint was SR. Secondary endpoints were complications, continence, satisfaction, and changes in quality of life measured by validated questionnaires.
*Results* Thirty patients underwent the T-plasty. Median age at surgery was 69 (IQR 62–73) years. Most patients had BNS due to TUR-P [$n = 25$ (83.3%)]. No severe blood loss or severe complications occurred perioperatively. Median FU was 45 (IQR 18–64) months. Three patients were lost to FU. Success rate was 100%. Compared to pre-OP $Q_{max}$, mean $Q_{max}$ post-OP improved significantly [pre-OP 6.79 (SD ± 4.76) ml/s vs post-OP was 24.42 (SD ± 12.61) ml/s; ($t(5) = 4.12$, $p = 0.009$)]. Mean post-void residual urine decreased significantly [pre-OP 140.77 (SD ± 105.41) ml vs post-OP 14.5 (SD ± 22.42) ml; ($t(9) = -3.86$, $p = 0.004$)]. One patient developed a de-novo-incontinence post-OP. Mean ICIQ-SF Score was 1.2 (SD ± 2.27). 88.5% of patients were *pleased or delighted* by surgery. 75% of patients claimed their quality of life has been (strongly) improved.
*Conclusions* The T-plasty is a valuable option as treatment of recurrent BNS. SR, rates of continence, and high patient satisfaction are very encouraging.

**Keywords** Benign hyperplasia of the prostate · Bladder neck · Bladder neck stenosis · Reconstructive urology · TUR-P

## Introduction

For symptomatic benign hyperplasia of the prostate (BPH), transurethral surgery is regarded as the gold standard after failed medical treatment. Besides classical transurethral resection of the prostate (TUR-P), other transurethral techniques are acknowledged as at least equal [1]. The incidence of bladder neck stenosis (BNS) after surgery for BPH varies. However, similar rates of occurrence after all types of transurethral procedures were demonstrated [2–5]. Potential risk factors for BNS include a low adenoma weight, extensive resection of the bladder neck (BN), and prostatitis at time of resection [6–8].

As the initial treatment of BNS endoscopic therapy is recommended [9]. For cold-knife incision, success rates are reported to be around 90% [10]; for transurethral resection of the BN, success rates are between 86 and 92% [9]. However, different studies showed a declining success rate after repeated transurethral surgery [9].

Highly recurrent BNS is, therefore, a rare but troublesome condition. There is no standard treatment defined.

Clemens M. Rosenbaum and Roland Dahlem have contributed equally.

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✉ Clemens M. Rosenbaum
rosenbaumclemens@gmail.com

[1] Department of Urology, University Medical Center Hamburg-Eppendorf, Martinistr. 52, 20246 Hamburg, Germany

Therapeutic options include intermittent dilatation, intermittent endoscopic procedures, permanent suprapubic drainage, urinary diversion, or open reconstruction [11–13]. One of the latter is the YV-plasty as initially introduced by Young [14, 15]. To this day, this technique is still one of the most accepted techniques for BN reconstruction. Usually, a wide BN with a flap of healthy tissue can be created. However, vascularization of the single flap may be impaired by distinct mobilisation and tension during suturing. Both factors may possibly lead to restenosis of the BN. To improve vascularity and guarantee mobility of the flaps, we improved this technique as described before [16].

The T-plasty is our attempt to use two instead of one flap to ensure a wider and more patent bladder neck can be reconstructed. Besides less tension impacting on the flaps, we try to improve vascularity. The potential risk of recurrence seems to be declined.

Our study reviews urethral patency, functional outcome, and patient satisfaction with a longer follow-up (FU) and in a threefold larger cohort than before.

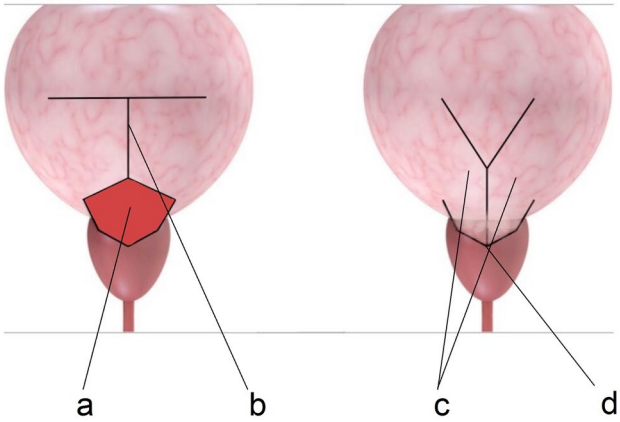


**Fig. 1** Schematic presentation of the type of incision of the anterior bladder wall. **a** Resected scar tissue at the bladder neck, **b** t-shaped incision at the anterior bladder wall, **c** two tension-free, well vascularised flaps, and **d** anastomosis of prostate cavity and the anterior prostatic urethra

## Patients and methods

### Study population

After obtaining Institutional Review Board approval, we identified all patients who underwent T-plasty of the BN for highly recurrent BNS due to transurethral treatment for BPH between December 2008 and July 2016. All patients had at least one failure of endoscopic treatment of BNS.

Preoperative patient assessment included medical history, physical examination, urine culture, uroflowmetry, post-void residual urine measurement, a combined retro- and antegrade cystourethrogram (RUG/AUG), and a urethroscopy.

### Surgical technique

A single shot of cefuroxime 1.5 g (i.v.) was given at time of surgery. No routine antibiotic prophylaxis was given afterwards.

Patients were placed in a supine position. Access was gained through an abdominal midline incision. Perivesical space and bladder neck were defined using the typical retropubic approach. After proper exposition of the bladder neck, scar tissue was excised (Fig. 1a) and anterior bladder wall was incised in a T-shaped manner (Fig. 1b) as described earlier [16]. Ureteral stents were placed routinely. Using the T-shaped incision, two tension-free, well vascularised flaps are created to reconstruct a wide bladder neck and anterior prostatic urethra (Fig. 1c). Both flaps are sutured to the healthy urethra distally of the bladder neck in a V-shape (Fig. 1d). Interrupted 3/0 polygalactic acid sutures were placed from distal to proximal. Transurethral and suprapubic catheter were placed. Bladder was closed in layers and control for leak tightness was performed.

Ureteral stents were routinely removed at days 7 and 8 after surgery. Removal of the transurethral catheter was performed 21 days after surgery followed by a VCUG. Voiding permission was given and suprapubic catheter removed in the absence of urinary extravasation and sufficient spontaneous micturition.

### Assessment of data

Data assessment is based on retrospective chart review of preoperative data, post-operative follow-up visits, and detailed standardized questionnaires, which were administered to each patient at time of follow-up. There was no standardized timing of the post-operative follow-up visits in our clinic. Patients were called by telephone querying on their current condition. Questionnaires inquired for recurrence of BNS, post-operative complications (defined by the Clavien–Dindo classification), continence, satisfaction, and changes in quality of life. As validated questionnaires, the IPSS, QoL, and ICIQ-SF were included (Appendix in ESM). Data collection and telephone calls were performed by one investigator (CMR).

Recurrence of BNS after T-plasty was determined as no need for further instrumentation such as catheterization, dilatation, internal urethrotomy, or open surgery. If not performed in our clinic, local urologists were contacted to obtain post-operative uroflowmetry and post-void residual urine measurement.

### Statistical analysis

Frequencies and proportions described categorical variables. Means, medians, and ranges were reported for continuously coded variables. The *t* test was used to compare the statistical significance of differences within paired samples. All statistical analyses were performed using SPSS® 20.0, with a two-sided significance level set at $p < 0.05$.

## Results

### Baseline characteristics

Baseline characteristics of the cohort are displayed in Table 1. Median age at surgery was 69 years [Interquartile range (IQR) 62–73]. The majority of patients had BNS due to TUR-P as the initial surgery [$n = 25$ (83.3%)]. Median number of prior endoscopic BN procedures was 3 (IQR 2–3, range 1–19). No patient underwent radiation therapy prior T-plasty. Mean $Q_{max}$ before surgery was 6.79 ml/s, mean post-void residual urine (PVRU) was 140.77 ml.

### Perioperative course and complications

Mean time of hospital stay was 13.2 (SD ± 2.66) days. Mean time of surgery was 110 (SD ± 28.63) min. No relevant blood loss was reported. No severe complications (according to Clavien–Dindo ≥ Grad III) occurred in the post-operative course. No wound healing defects or wound infections occurred. One patient had a documented urinary tract infection that could be managed by antibiotics.

### BNS recurrence after T-plasty

Median FU was 45 (IQR 18–64) months. Three patients were lost to FU, leaving 27 patients for further analysis.

**Table 1** Baseline characteristics of 30 patients before T-plasty

| | |
|---|---|
| Age, median (IQR) (years) | 69 (62–73) |
| ASA Score | |
| 2, *n* (%) | 21 (70) |
| 3, *n* (%) | 9 (30) |
| Initial therapy | |
| TUR-P, *n* (%) | 25 (83.3) |
| HoLEP, *n* (%) | 3 (10) |
| Greenlight laser, *n* (%) | 2 (6.7) |
| Prior BN procedures, median (IQR) | 3 (2–3) |
| $Q_{max}$ pre-OP (ml/s), mean (SD) | 6.79 (4.76) |
| PVRU (ml), mean (SD) | 140.77 (105.41) |

*ASA* American Society of Anesthesiologists score, *BN* bladder neck, *PVRU* post-void residual urine

Success rate was 100%; one patient ended up by permanent catheter drainage due to acontractile bladder diagnosed 6 years after T-plasty.

Mean $Q_{max}$ post-operatively was 24.4 ml/s (SD ± 12.61). $Q_{max}$ improved significantly compared to preoperative $Q_{max}$ ($t(5) = 4.12$, $p = 0.009$). Mean PVRU post-operatively was 14.5 ml (SD ± 22.42). PVRU decreased significantly compared to preoperative PVRU ($t(9) = -3.86$, $p = 0.004$). Median IPSS was 6 (IQR 3–10) and median QoL was 1 (IQR 1–1). 72% of patients claimed that their urinary stream was normal to moderately reduced. Median number of nocturia episodes was 1 (IQR 0–2).

### Urinary continence

Three patients (11.1%) claimed to be incontinent post-operatively (two cases of stress incontinence and one case of urge incontinence). Two of these three patients stated that their incontinence was unchanged to preoperative incontinence. Mean ICIQ-SF Score was 1.2 (SD 2.27). Median number of pads used was 0 [IQR 0–0; two patients (7.4%) claimed they would use one security pad per day].

### Quality of life

88.5% of patients were *pleased or delighted* by surgery and 75% of patients experienced a strongly improved or improved quality of life. Of those patients who were not satisfied, one patient ended up by permanent catheter drainage due to acontractile bladder, one patient developed a de-novo-incontinence, and one patient has been treated 19 times endoscopically before T-plasty.

## Discussion

We confirm highly encouraging the initial results in the long-term outcome of BN patency after T-plasty. We were able to show high satisfaction *rate*. Rates of urinary incontinence are satisfying, as well. Therefore, the T-plasty represents a valuable option for patients suffering of recurrent BNS after repeat endoscopic therapies.

Even though rates of BNS have declined from 16 to 3.4% in the past decades [17, 18], it is still one of the most common side effects of TUR-P [2, 3]. However, BNS does not only occur after TUR-P. Rates of BNS after photoselective vaporization [4, 5] or laser enucleation are comparable [1]. Generally accepted risk factors for BNS are extensive resection in the area of the BN and small prostate glands [18]. In the case of prostatitis, the risk is even increased [6]. Usually, BNS occurs within the first year after transurethral prostatectomy [7].

Unlike in vesicourethral anastomosis stenosis after radical prostatectomy, simple dilatation is rarely successful in BNS [19]. For cold-knife incision, success rates are reported to be around 90% [10]; for transurethral resection of the BN, success rates range between 86 and 92% [9]. Different studies showed a declining success rate after repeated transurethral surgery for BNS [20]. Therefore, highly recurrent BNS is a rare but troublesome condition. Besides repeated endoscopic treatment, intermittent dilatation or permanently suprapubic drainage is treatment options. However, many patients opt for a permanent solution without permanent catheter drainage. Urinary diversion and open reconstruction of the BN are possible options. Some authors advocate an open surgical approach after failure of endoscopic treatments [11, 21], whereas the most popular technique is the YV-plasty [15] as described by Young. However, vascularization may be impaired by extensive mobilisation and tension during suturing, potentially leading to recurrent stenosis.

Advantages of the T-plasty are the potential improve of vascularity and mobility of the utilized flaps. This consideration is proven true by the high success rate of our technique. No patient needed further surgery, objective measures as $Q_{max}$ and PVRU improved significantly and the majority of patients claimed that their urinary stream was normal to only moderately reduced. Excellent rates of bladder neck patency can, therefore, be reached with our technique.

Besides the high success rate, rates of urinary continence are satisfactory, as well. Whereas other authors show an incontinence rate of almost 100% [12], the T-plasty guarantees low rates of de-novo-incontinence. Only one patient claimed to suffer of new onset incontinence. If this represents a de-novo incontinence or if preexisting incontinence presenting as pseudo-continence was unmasked cannot be evaluated by our data. Mean ICIQ-SF Score of 1.2 and no use of more than one pad per day (two patients claimed that they would use one security pad per day) among patients underscore these findings. Most of all, we advocate the retropubic instead of the transperineal approach for this satisfying results.

Another advantage of the retropubic approach is the perioperative morbidity. The extreme positioning needed to have a proper transperineal exposition can be a contraindication for some of the elderly patients. Further on, we saw low complications rates in the post-operative course.

The YV-plasty is an efficient and established technique. We define the T-plasty more as an improvement rather than a replacement of this technique. Surgeons regularly performing YV-plasties should be able to adapt to this technique quickly. Patients presenting with recurrent BNS often had to undergo multiple prior procedures. This high number of failed operations can result in psychological strain for the patients. Therefore, it is our attempt to ensure best results possible. Not only BN patency and rates of urinary continence encourage us but also the high rates of patient's satisfaction: the vast majority of patients were *pleased or delighted*. 75% of patients claimed that their quality of life has been improved or strongly improved.

There are several limitations to our study. First of all, it is retrospective nature of the study and the relatively small number of patients. Furthermore success was defined as the absence of for further instrumentation and no objective measurement besides uroflowmetric assessment was available. The missing standardized follow-up schedule is another drawback.

However, as recurrent BNS is a rare problem, the number of patient compared to the literature is still high. To the best of our knowledge, this is the largest contemporary study of patients suffering of recurrent BNS after surgery for BPH. Especially, compared to other more invasive techniques, the T-plasty is a valuable treatment option for highly recurrent BNS due to high success rates, low rates of incontinence, and excellent patient satisfaction.

**Author contributions** CMR: protocol development, data collection and management, data analysis, and manuscript writing; RD: protocol development, data management, and manuscript editing; VM: data management and manuscript editing; LAK: protocol development and manuscript editing; MWV: manuscript editing; MF: protocol development and manuscript editing; VS: manuscript editing; CPR: protocol development and manuscript editing.

**Compliance with ethical standards**

**Conflict of interest** The authors declare that they have no conflict of interest.

**Ethical approval** All procedures performed in this study were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki declaration and its later amendments.

**Informed consent** Informed consent was obtained from all individual participants included in the study.

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