

# Comparison of plasmakinetic transurethral resection of the prostate with monopolar transurethral resection of the prostate in terms of urethral stricture rates in patients with comorbidities

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**Purpose:** To compare urethral stricture rates in comorbid patients undergoing plasmakinetic transurethral resection of the prostate (PK-TURP) and monopolar transurethral resection of the prostate (M-TURP) for benign prostatic hyperplasia.

**Methods:** The data of 317 patients with comorbidities undergoing either PK-TURP or M-TURP from September 2008 to December 2012 were retrospectively evaluated. Preoperative and postoperative 12-month International Prostate Symptom Score, maximal flow rate, postoperative International Index of Erectile Function scores, and urethral stricture rates were evaluated.

**Results:** A total of 154 patients underwent M-TURP and 163 patients underwent PK-TURP. Urethral stricture rates were 6/154 in the M-TURP treatment arm and 17/163 in the PK-TURP treatment arm ( $P=0.000$ ). In the presence of hypertension and/or coronary artery disease and/or diabetes mellitus, the risk of urethral stricture complication was significantly higher in the PK-TURP group than in the M-TURP group ( $P=0.000$ ).

**Conclusions:** The risk of urethral stricture increases with PK-TURP in elderly patients with a large prostate and concomitant hypertension and/or coronary artery disease and/or diabetes mellitus. Therefore, PK-TURP should be performed cautiously in this group of benign prostatic hyperplasia patients.

**Keywords:** Prostatic hyperplasia, Comorbidity, Transurethral resection of prostate, Urethral stricture

## INTRODUCTION

For many years, monopolar transurethral resection of the prostate (M-TURP) has been the standard method for treating lower urinary tract symptoms (LUTS) resulting from benign prostatic hyperplasia (BPH) with immediate success in relieving the obstruction and with improvement of symptoms and voiding variables in the long run [1]. The reasons for the worldwide acceptance of this method include not only its good results, but also the low incidence of complications [2].

Nevertheless, M-TURP still requires hospitalization and can be complicated by intraoperative bleeding, clot retention, and transurethral resection (TUR) syndrome [3]. M-TURP is limited to prostate glands weighing less than 100 g and is associated with significant complications and morbidity if a larger prostate is resected. Therefore, a demand for technological alternatives that can decrease the risks of M-TURP, such as hemorrhage or electrolyte disturbances and TUR syndrome, remains [3,4].

In this context, plasmakinetic or bipolar technology has

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recently gained worldwide attention, with the aim of minimizing the morbidity of the standard M-TURP procedure while maintaining efficacy and durability [5]. Unlike M-TURP, bipolar technologies allow the electric current to complete the circuit without passing through the patient. This allows saline solution to be used instead of glycine for irrigation during resection. Thus, it reduces the risk of hyponatremia during TURP [5]. A concern for the occurrence of urethral stricture that could be a specific pitfall of plasmakinetic transurethral resection of the prostate (PK-TURP) was raised in recent years as the increasing number of patients with this complication became clinically relevant and alarming, even though the urethral stricture rate in the PK-TURP group compared with the M-TURP group was not statistically significant [6]. This issue was also noticed in our previous study [7]. However, although urethral stricture rates were higher in the PK-TURP group, statistical significance was not reached, probably because of the limited number of patients. Therefore, in the present study, a larger sample of patients undergoing either M-TURP or PK-TURP with similar technical equipment and clinical conditions was included in our series with the aim of obtaining sufficient data to evaluate the significance of the urethral stricture rate in the PK-TURP arm.

## MATERIALS AND METHODS

### 1. Study design

The data of 317 patients with comorbidities who underwent either PK-TURP or M-TURP in two institutions (Taksim Teaching Hospital and Maltepe University Hospital, Istanbul, Turkey) from September 2008 to December 2012 were retrospectively evaluated. Formal study approval by the Institutional Review Board of Maltepe University (MAL.UN.KAEK/MEG.27.2011/22) was obtained. Data for preoperative International Prostate Symptom Score (IPSS), maximal flow rate (Qmax), residual urine volume, International Index of Erectile Function (IIEF), and comorbidities such as hypertension (HT), coronary artery disease (CAD), diabetes mellitus (DM), and chronic obstructive pulmonary disease (COPD) were reviewed. Sodium levels before the procedure and at 2 hours and hemoglobin levels before and at 24 hours were recorded postoperatively. Treatment efficacy was evaluated at 12 months postoperatively by comparing Qmax, IPSS, IIEF scores, and urethral stricture rates. Inclusion criteria were age > 50 years, good performance status, acute urinary retention if catheter removal failed after therapy with alpha-blockers or chronic urinary retention unresponsive to medical treatment, IPSS  $\geq$  8, and Qmax  $\leq$  15 mL/sec. Exclusion criteria were prostate volume < 30 cm<sup>3</sup>, docu-

mented or suspected prostate cancer, neurogenic bladder, bladder stone or diverticula, urethral stricture, and maximal bladder capacity > 500 mL. None of the patients had a history of urethral catheterization. Patients with low maximum and average flow rates at the postoperative follow-up underwent cystoscopy so that urethral stricture could be diagnosed and treated by internal urethrotomy.

### 2. Equipment

The electroresection and coagulation for M-TURP were performed with a standard tungsten wire loop by use of a high-frequency current having a maximum cutting power of 200 W and coagulating power of 80 W. In the M-TURP application, a 26-F resectoscope, a 30° wide-angled optic, a wire loop electrode (Storz, Tuttlingen, Germany), and 1.5% glycine solution were used. The Gyrus Plasmakinetic System for PK-TURP consists of a generator and a cutting loop that does not differ in shape from a monopolar loop but has an active and return electrode on the same axis, separated by a ceramic insulator. A chip in the loop automatically adjusts the power setting of the generator for the best cutting and coagulating parameters. In the PK-TURP application, a 26-F resectoscope, a 30° wide-angled optic, and saline solution were used. All operations were performed by using a similar technique under spinal or general anesthesia. A 22-F three-way urinary catheter was left in place after the operation for 3 days, and saline irrigation was continued until the effluent fluid was completely clear.

### 3. Statistical analysis

Statistical analyses were performed by using SPSS ver. 17.0 (SPSS Inc., Chicago, IL, USA). The results were analyzed by using descriptive statistics with the nonparametric Mann-Whitney *U*-test and chi-square test (or Fischer exact test), where appropriate, to compare continuous variables and categorical data, respectively. For the multivariate analysis, the possible factors that were identified in the univariate analysis were analyzed to determine independent predictors of urethral stricture. Hosmer-Lemeshow goodness-of-fit statistics were used to assess model fit. Differences were considered statistically significant at a *P*-value of less than 0.05.

## RESULTS

One hundred fifty-four patients underwent M-TURP and 163 patients PK-TURP. Comorbidities in both treatment arms were similar (Table 1). The mean ages of the M-TURP and PK-TURP groups were 64.4  $\pm$  8.3 and 69.0  $\pm$  8.0 years, respectively (*P* = 0.00). Prostate volumes were 42.6  $\pm$  12.6 mL in the PK-

TURP and 72.2±25.4 mL in the M-TURP group, respectively ( $P=0.00$ ). Preoperative IPSS scores were 19.3±7.9 in the M-TURP and 25.6±7.6 in the PK-TURP group, respectively ( $P=0.00$ ). There were no significant differences in terms of preoperative IIEF scores, Qmax, or postvoid residual between the two groups (Table 2). The operative times were 60.8±17.2 and 60.0±23.5 minutes, respectively ( $P=0.17$ ). The mean difference in Hb level at the 24-hour follow-up (g/dL) was lower in the PK-TURP group than in the M-TURP group (-1.4±1.1 and -2.0±1.0, respectively,  $P=0.00$ ). Four patients in the M-TURP group required blood transfusion. The mean difference in serum sodium level at the 2-hour follow-up (mg/dL) was lower in the PK-TURP group (-4.4±4.3 and -10.8±4.4, respectively,  $P=0.00$ ). The catheterization time and length of hospital stay were 3 days irrespective of the operation modalities. Serum creatinine levels were 1.1±0.2 mg/dL in the M-TURP and 1.2±0.2 mg/dL the in PK-TURP arm. At 12 months postoperatively, IPSS was lower whereas IIEF scores were higher in PK-TURP patients than in M-TURP patients (M-TURP, 10.0±7.4 vs. PK-TURP, 8.3±7.3,  $P=0.00$ ; and M-TURP, 16.0±6.4 vs. PK-TURP, 18.2±8.7,  $P=0.00$ , respectively). Qmax values were similar in both M-TURP and PK-TURP treat-

ment arms (20.0±5.0 vs. 19.1±6.2, respectively). The urethral stricture rate was significantly higher in the PK-TURP group (17/163) than in the M-TURP group (6/154) ( $P=0.025$ ) (Fig. 1).

When the univariate analysis was performed, age, prostate volume, and comorbidities were found to be risk factors for urethral stricture. Because age and prostate volume were significantly different in both treatment arms, this result should be regarded as a selection bias. However, regardless of the operation modalities, when prostate volume is larger than 80 mL, the risk of urethral stricture increases ( $P=0.000$ ). Particularly in the presence of HT and/or CAD and/or DM, the risk was significantly higher in the PK-TURP group than in the M-TURP group ( $P<0.05$ ) (Table 3). When multivariate analysis including the factors that were statistically significant in the univariate analysis was performed, it was observed that HT+DM and HT+DM+CAD were statistically powerful predictive factors for urethral stricture occurrence (Table 4). No bladder neck stricture was seen among patients at 12 months postoperatively.

**Table 1.** Distribution of comorbidities in M-TURP and PK-TURP patients

Comorbidity	Operation modality		Total
	M-TURP	PK-TURP	
HT	68	72	140
HT+CAD	12	15	27
COPD	16	14	30
DM	15	12	27
HT+COPD	5	8	13
HT+CAD+DM	18	20	38
HT+CAD+COPD	7	6	13
HT+DM	10	13	23
HT+DM+COPD	1	2	3
DM+COPD	2	1	3
Total	154	163	317
P-value	0.978		

M, monopolar; PK, plasmakinetic; TURP, transurethral resection of the prostate; HT, hypertension; CAD, coronary artery disease; COPD, chronic obstructive pulmonary disease; DM, diabetes mellitus.

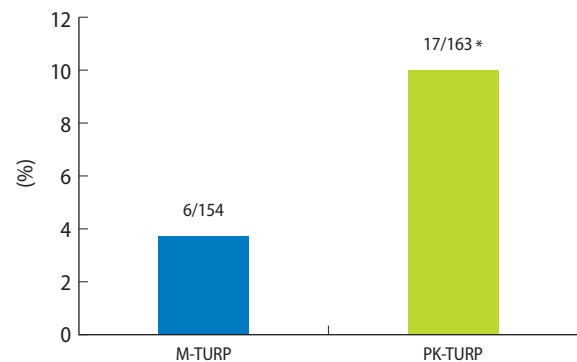
**Table 2.** Preoperative characteristics of the patients

Operation modality	Age (yr)	Prostate volume (mL)	IPSS	Qmax (mL/sec)	PVR volume (mL)	IIEF
M-TURP (n=154)	64.4±8.3	42.6±12.6	19.3±7.9	8.7±2.8	122.0±61.0	16.8±6.3
PK-TURP (n=163)	69.0±8.0	72.2±25.4	25.6±7.6	8.5±4.2	131.5±73.7	15.1±8.5
P-value	0.00	0.00	0.00	0.96	0.51	0.23

M, monopolar; PK, plasmakinetic; TURP, transurethral resection of the prostate; IPSS, International Prostate Symptom Score; Qmax, maximum flow rate; PVR, postvoid residual; IIEF, International Index of Erectile Function.

## DISCUSSION

The average lifespan in elderly men has been extended with advances in health care accessibility and diagnostic and treatment modalities in the past decades [8]. However, this advantage has come with an increase in age-related diseases, such as BPH. High-risk patients with BPH are defined as elderly



**Fig. 1.** Percentage of urethral stricture in the treatment arms. M, monopolar; PK, plasmakinetic; TURP, monopolar transurethral resection of the prostate. \* $P=0.025$ .

**Table 3.** Distribution of comorbidities in M-TURP and PK-TURP patients with urethral stricture complication

Comorbidity	Urethral stricture		Total
	Absent	Present	
HT	137	3	140
HT+CAD	24	3*	27
COPD	29	1	30
DM	27	0	27
HT+CAD+DM	28	10*	38
HT+CAD+COPD	12	1	13
HT+DM	19	4*	23
HT+DM+COPD	2	1	3
DM+COPD	3	0	3
HT+COPD	13	0	13
Total	294	23	317
P-value	0.000		

M, monopolar; PK, plasmakinetic; TURP, transurethral resection of the prostate; HT, hypertension; CAD, coronary artery disease; COPD, chronic obstructive pulmonary disease; DM, diabetes mellitus.

\*P<0.05.

patients with concomitant cardiovascular, pulmonary, and other organ diseases. These patients are at a significant risk of complications during surgery [9]. Although several authors have reported that a conservative treatment is sufficient to relieve LUTS in elderly comorbid patients with BPH, the long-term therapeutic effect is poor and the potential of symptom recurrence is high, especially in cases with large prostate volumes [10].

In recent years, the number of elderly BPH patients with comorbidities who meet the criteria for recommended surgery has increased [11]. Therefore, surgical procedures that will provide the safest and most efficient outcomes in this subset of the population become necessary. M-TURP still represents the gold standard in the operative management of BPH. However, this procedure has complications such as hemorrhage or electrolyte disturbances (TUR syndrome), perforation, and long-term urethral strictures [12,13]. To reduce the complications of M-TURP, various electroresection technologies have been introduced with varying success. PK-TURP using bipolar energy has demonstrated promising early results among these modalities. Its perioperative results are comparable with those obtained with M-TURP, whereas its postoperative outcomes are more favorable [14,15]. The saline solution used for irrigation in PK-TURP reduces the possibility of TUR syndrome. The bipolar current has no impact on heart electrophysiology and ensures the safety of the operation. Finally, PK-TURP has been demonstrated to be more effective than M-TURP in resecting large volumes of prostate tissue [16]. These above-mentioned factors suggest

**Table 4.** Multivariate analysis of risk factors in M-TURP and PK-TURP patients with urethral stricture complication

Risk factor	OR	95% CI	P-value
Age	1.253	1.046–1.272	0.004
Prostate volume	1.053	1.030–1.076	0.000
HT+DM	9.917	1.646–59.743	0.012
HT+CAD	1.638	0.274–9.786	0.589
HT+ DM+CAD	14.959	3.427–65.303	0.000

M, monopolar; PK, plasmakinetic; TURP, transurethral resection of the prostate; OR, odds ratio; CI, confidence interval; HT, hypertension; DM, diabetes mellitus; CAD, coronary artery disease.

that PK-TURP is a reliable resection modality in the elderly and comorbid patients having large prostates.

Taking into consideration the results of previous studies reporting the improved safety profile of PK-TURP, we studied patients with older age, larger prostate volumes, and comorbidities such as HT, CAD, DM, and COPD who underwent the PK-TURP procedure in two institutions. In our study, despite the older age, larger prostate volumes, and higher IPSS in the PK-TURP group, variations in Hb level at postoperative 24 hours, serum sodium at perioperative 2 hours, and IPSS at postoperative 12 months were significantly lower with higher IIEF scores at postoperative 12 months. This was explained as follows. First, unintended stimulation of nearby nerves during monopolar resection may be avoided with bipolar resection. Second, bipolar energy may offer some advantages with respect to the reduction of conductive trauma (i.e., tissue charring), because the high-frequency current generated by a bipolar instrument tends to remain superficial (depth, 0.5–1 mm) compared with the current generated by a monopolar device (depth, 3–5 mm) [17,18]. This superficial depth and absence of a return current with the PK-TURP instrument may reduce the risk of burns, which consequently decreases urethral or bladder neck stricture rates.

In a very recent study, urethral stricture was found in 9 patients (7.3%) from the M-TURP arm and 12 patients (7.1%) from the PK-TURP arm [19]. Bladder neck contracture occurred in 3 patients (2.4%) from the M-TURP arm and 2 patients (1.2%) from the PK-TURP arm. The age and prostate volumes in both M-TURP and PK-TURP groups were similar in this series. In contrast with previous reports, our study revealed higher urethral stricture rates in the PK-TURP arm than in the M-TURP arm. It is worth mentioning that the strictures were confined to the pendular urethra, whereas no bladder neck strictures were seen in our patients.

Because the bipolar current remains superficial and provokes lower conductive trauma, the high incidence of urethral strictures might be explained by mechanical trauma.

However, the mean operative times in both groups were similar, although the prostate volume in the PK-TURP arm was higher and the time interval for a given unit of resected tissue was shorter. This could be interpreted as meaning that urethral tissues were exposed to similar duration of trauma by both the M-TURP and PK-TURP resectoscope shafts. Nevertheless, we speculate that either increased age in the PK-TURP arm or increased frequency and speed in the back and forth movements of the bipolar resectoscope by the operator (owing to improved vision and hemostasis) may be responsible for the increased stricture rates. Additionally, HT and/or CAD and/or DM are conditions that affect the vital supply of tissues including the urethra and that could be potential risk factors for the occurrence of urethral stricture.

There were limitations to our study. First, it was retrospective in nature, and second, the mean preoperative prostate volume and age were higher in the PK-TURP group than in the M-TURP group.

In conclusion, PK-TURP is effective for treating BPH patients having comorbidities with the additional advantages of reduced early postoperative complications and superior clinical outcome compared with M-TURP. However, the significantly higher urethral stricture rates in the PK-TURP group deserve further investigation. Furthermore, bipolar resection of larger prostates in elderly patients with HT+DM and HT+CAD+DM should be performed cautiously.

## CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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