

Research Article

Robotic-assisted simple prostatectomy versus holmium laser enucleation of the prostate for large benign prostatic hyperplasia: A single-center preliminary study in Korea

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ABSTRACT

Background: Holmium laser enucleation of the prostate (HoLEP) and robotic-assisted simple prostatectomy (RASP) are the two most important therapeutic modalities for large benign prostatic hyperplasia. However, there are currently no studies comparing these two treatments in a Korean setting. In this study, the authors seek to compare the safety and efficacy associated with these procedures.

Methods: The authors retrospectively analyzed 59 male patients who underwent HoLEP (n = 26) or RASP (n = 33) at single center. The following preoperative data were compared: age, the International Prostatic Symptom Score (IPSS), transrectal ultrasonography, uroflowmetry, and hemoglobin. Intraoperative data included operation time and specimen weight. Postoperative data included change in IPSS, uroflowmetry, and hemoglobin. Length of stay, catheterization time, and complications were also reviewed.

Results: No significant differences between the two groups were found in terms of age, total prostate, and transitional volume. Postoperatively, both groups showed similar improvement in the maximum flow rate, post-void residual urine, IPSS, and quality of life. Intraoperatively, there were no differences regarding operation time and resected prostate volume. Catheter removal time and length of stay were significantly shorter in the HoLEP group than the RASP group. In addition, postoperative hemoglobin changes were significantly lower in the HoLEP group. However, incontinence rates at 1 month and 2 months postoperative in the RASP group were lower than the HoLEP group.

Conclusions: Both HoLEP and RASP can produce excellent postoperative outcomes. However, catheter removal time, length of stay, and hemoglobin changes were more favorable in the HoLEP group. On the other hand, postoperative incontinence was more favorable in the RASP group. These factors must be heavily considered when deciding surgical the method for large benign prostatic hyperplasia.

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1. Introduction

In Korea, the incidence of benign prostatic hyperplasia (BPH) was 11,610 per 100,000 men and increases with age.¹ The effects of BPH can significantly impact a patient's quality of life. Therapeutic options for BPH are diverse, ranging from medical therapy to a combination of both drug therapy and surgical approach. While medication is the first-line treatment for BPH, surgical intervention is needed in unresolved symptoms, as well as in complicated cases

(recurrent UTIs, bladder stones, large diverticulum, hematuria, and renal insufficiency).²

Currently, the surgical management of large BPH remains controversial. Surgical methods have evolved over the past decades, with the inclusion of traditional open simple prostatectomy (OSP), transurethral techniques including transurethral resection of the prostate (TURP), holmium laser enucleation of the prostate (HoLEP), laparoscopic simple prostatectomy (LSP), and robotic assisted simple prostatectomy (RASP). The selection of surgical procedure is challenging, especially in the setting of a large prostate. In the past, OSP has traditionally been the “gold standard” for large prostate. According to the 2020 American Urological Association (AUA) guideline, only simple prostatectomy and laser enucleation are feasible for large prostates.³

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In these days, HoLEP has been established as a standard treatment method for all sizes of prostate. In Korea, TURP was the most common surgical method for BPH treatment.⁴ However, TURP usage showed a decreasing pattern, while HoLEP showed the opposite. It is still important to consider that HoLEP also has several limitations, especially the steep learning curve.^{5,6} With the increasing use of robotic in urology surgery, RASP has been performed by several surgeons for large prostate glands.⁷ RASP, compared to OSP, provides a decreased length of hospital stay, blood loss, and transfusion prevalence.⁸ Korean data also showed that complications of bleeding are significantly less prevalent in RASP.⁹

Today, HoLEP and RASP are the most important therapeutic techniques for the management of large BPH. However, there are no studies comparing these two treatments in the Korean setting. Herein, the authors seek to compare the safety and efficacy associated with these two procedures.

2. Materials and methods

2.1. Patient and material

The authors retrospectively analyzed the medical records of total 59 male patients who were amenable for follow-up for at least 6 months from a sample of patients who underwent HoLEP ($n = 26$) or RASP ($n = 33$) at the Keimyung University Dongsan Medical Center between January 2018 and May 2021. This study was approved by the Institutional Review Board (DSMC 2022-01-011). HoLEP or RASP were considered rather than TURP in cases where one or more of the following conditions was present: large gland BPH with prostate volume >80 ml, massive intravesical prostatic protrusion, large or multiple bladder calculi, or large bladder diverticulum. HoLEP or RASP were performed by two surgeons who have significant experience on BPH treatment. Before deciding on surgery, we performed the preoperative prostate biopsy in patients with high prostate specific antigen (PSA) in 25/59 (42.36%). If the patients did not undergo a biopsy, we explained the possibility of prostate cancer and proceeded the surgery.

The following preoperative data were compared: age, the International Prostatic Symptom Score (IPSS), transrectal ultrasonography, uroflowmetry, and hemoglobin. Intraoperative data included surgical time and specimen weight. For HoLEP, the operative time included enucleation plus morcellation time. Postoperative data included change in IPSS, uroflowmetry and hemoglobin, need for transfusion, length of stay, catheterization time, and all complications occurring during perioperative period were classified according to the modified Clavien system.¹⁰ Urinary incontinence (UI) rate at postoperative 2 weeks, 1 month, and 2 months was also assessed.

2.2. Operation methods

2.2.1. HoLEP

A 26F continuous flow resectoscope (Karl Storz Endoscopy, Culver City, CA) with a laser bridge housing a 7F stabilizing catheter (Cook Urologic, Spencer, IN) was used to enucleate the prostate. High-powered HoLEP was performed, and holmium laser instruments were used (2.0 J, 30–50 Hz, 60–100 W, reusable 550-nm laser fibers: Lumenis, Inc, Palo Alto, CA, USA). In essence, the median and the lateral prostatic lobes were dissected off the surgical capsule in a retrograde fashion from the apex toward the bladder. The lobes were enucleated in their entirety, pushed into the bladder, and fragmented with the use of a mechanical tissue morcellator (Versacut; Lumenis, Inc, Palo Alto, CA, USA). During HoLEP and mechanical tissue morcellation, 0.9% of normal saline was used

as irrigation solution. Histological examination was performed on all retrieved and collected tissue. Postoperative bladder irrigation was applied as necessary, and a voiding trial was given on postoperative day 1. Majority of subjects were discharged without a catheter in place.

2.2.2. RASP

RASP was performed using the 4-arm da Vinci® Xi or X Surgical Systems, with the patient placed in a Trendelenburg position after general anesthesia. The dome of the bladder was identified, and a midline cystotomy was done to gain transvesical access to the prostate. Starting between both ureteral orifice and posterior prostate, an incision was made in the mucosa overlying the adenoma. Once the plane between the prostatic capsule and the adenoma was identified, enucleation was performed using cauterization or blunt dissection of monopolar scissors. If necessary, a traction suture was placed on the prostate lobe of the adenoma to aid with dissection. Upon completion, hemostasis was obtained by direct cautery and suture ligation of specific bleeding points in the prostatic fossa. A 22 F two-way Foley catheter was inserted with the 30 ml balloon, and two-layer closure was performed on the cystotomy site using 2-0 MONOFIX sutures (Samyang Biopharmaceuticals Corporation, Korea). No drain placement was done, and the specimen was finally extracted by 12 mm assistant port with morcellation.

2.3. Statistical analysis

All statistical analyses were performed in SPSS program, ver. 25.0 (IBM Co., Armonk, NY, USA). Categorical variables were compared between the groups using the chi-square, Fisher's exact test, or linear-by-linear association, where appropriate. One-way analysis of variance or Student's t-test was used for continuous variables. P-values less than 0.05 were considered to be statistically significant.

3. Results

Comparing the HoLEP and RASP groups, no significant differences were found in terms of age (68.1 vs. 70.8 years, $P = 0.26$), preoperative PSA (5.19 vs. 7.17 ng/mL, $P = 0.11$), preoperative total prostate volume (97.9 vs. 84.1 g, $P = 0.14$), and transitional volume (50.6 vs. 45.3 g, $P = 0.18$). The baseline preoperative data are outlined in [Table 1](#).

Postoperatively, both groups showed similar improvement in the PSA levels (6.39 vs. 4.66 ng/mL, $P = 0.14$), the IPSS (obstructive score [9.4 vs. 10.9, $P = 0.29$], irritative score [1.9 vs. 3.8, $P = 0.11$]), and quality of life (2.2 vs. 2.0, $P = 0.79$), the maximum flow rate (Qmax) (13.2 vs. 13.4 ml/s, $P = 0.92$), the post-void residual urine (PVR) (98.9 vs. 127.2 ml, $P = 0.38$) ([Fig. 1](#)).

Between the two groups, no significant difference was observed regarding operation time (128.6 vs. 140.0 min, $P = 0.42$) and resected prostate volume (49.3 vs. 42.2 g, $P = 0.26$). In HoLEP group, urethral catheter removing time (7.0 vs. 2.5 days, $P < 0.01$) and length of stay (7.1 vs. 2.5 days, $P < 0.01$) were significantly shorter than the RASP group. In addition, postoperative hemoglobin changes were significantly lower than HoLEP group (1.8 vs. 0.7 g/dL, $P < 0.01$). However, neither groups necessitated transfusion.

All adverse events classified as treatment-related were assigned the modified Clavien classification system during the follow-up period ([Table 2](#)). The grade I: One patient in the HoLEP group developed acute urinary retention after the removal of the urethral catheter that required recatheterization. On the other hand, two patients in the RASP group and one patient in the HoLEP group visited due to hematuria with clot retention requiring clot evacuation. Most complications belonged to the grade II included 24 vs.

Table 1
Baseline characteristics of the patients

Characteristics	RASP (n = 33)	HoLEP (n = 26)	P value
Mean age, years (SD)	68.1 (10.1)	70.8 (7.6)	0.26
Mean total prostate volume, g (SD)	97.9 (37.9)	84.1 (31.3)	0.14
Mean transitional zone volume, g (SD)	50.6 (29.8)	45.3 (21.1)	0.18
Intravesical prostate protrusion, n (%)			
No	12 (36.4)	11 (42.4)	0.15
Yes	21 (63.6)	15 (57.6)	0.13
Bladder calculi, n (%)	1 (3.0)	1 (3.8)	0.92
Bladder diverticulum, n (%)	1 (3.0)	0 (0.0)	0.89
Preop BPH medications, n (%)			
alpha blocker	33 (100.0)	26 (100.0)	0.92
5-alpha reductase inhibitor	30 (90.0)	19 (73.0)	0.41

RASP, robotic assisted simple prostatectomy; HoLEP, holmium laser enucleation of the prostate; BPH, benign prostate hyperplasia.

13 patients in the RASP vs. HoLEP: postoperative stress UI, urgency, urge UI, and dysuria requiring medication occurred in 3 vs. 4 patients, 11 vs. 9 patients, 12 vs. 6 patients, 0 vs. 3 patients, respectively. Lastly, grade IIIb complication included 1 case: one patient in the RASP group required surgical intervention for adverse event, bladder neck contracture which required urethrotomy 3 months after RASP. No grade IV and V complications occurred.

Preoperatively, 3 (11.5%) of 26 patients in HoLEP group and 5 (15.1%) of 33 patients in RASP group complained of some degree of urge UI. However, no patient complained of stress UI before the surgery. *De novo* urgency and urge UI was the symptoms most commonly reported after surgery. After HoLEP, 13 (56.5%) of 26 patients who did not report urgency preoperatively had *de novo* urgency and 6 (23.0%) of 26 patients had *de novo* urge UI. And after RASP, 24 (72.7%) of 33 patients had *de novo* urgency and 12 (36.3%) of 33 patients had *de novo* urge UI. The most of which resolved within 1–6 months after management with b3 agonist or anticholinergic medications.

The *de novo* stress UI (pure stress UI plus mixed UI) rate was not significantly different between both groups on the 2 week visit (RASP vs. HoLEP, 9.1 vs. 15.4%, $P = 0.09$) and on the 1 month visit (RASP vs. HoLEP, 3.0 vs. 15.4%, $P = 0.09$). On the 2 month visit, all cases after RASP was resolved, except in four patients after HoLEP who still needed pelvic floor muscle exercises (RASP vs. HoLEP, 0.0 vs. 15.4%, $P = 0.03$).

4. Discussion

Currently, HoLEP has become the new 'gold-standard' for the surgical treatment of BPH.¹¹ In Korea between 2012 and 2016, HoLEP usage showed an increase from 19.4% to 39.7% of total BPH surgery.⁴ HoLEP provides several advantages including shorter catheterization time and hospital stay, less bleeding, a lower complication and reoperation rate.¹² It is also considered safe in patients receiving an anticoagulant and does not significantly influence hemoglobin level. In addition, HoLEP is easy and safe technique in patients with a prior history of prostate surgery and a need for retreatment due to the regrowth of adenoma. Furthermore, HoLEP is a size-independent treatment option for BPH with average gland size from 36 g to 170 g. Therefore, HoLEP is the only procedure that is AUA guideline-endorsed for all prostate sizes for the surgical treatment of BPH.³

As with other surgical techniques, HoLEP has several limitations. In example, sufficiency in performing HoLEP requires new equipment. To add, HoLEP has a difficult to learn.⁷ Several studies concluded that almost 50 cases were needed for an efficient HoLEP surgery.^{5,6} Furthermore, persistence of high rates of retrograde ejaculation and transient stress incontinence seem to limit the adoption of HoLEP by established urologists.

These limitations have led to the search for alternative surgical methods. With the increasing use of robotic surgery for Robot-assisted radical prostatectomy in Urology, several teams have explored the option of performing RASP in large prostate glands. This is due to RASP offering stereoscopic vision, free movement like hands, and easy learning curve. Sotelo et al.¹³ were the first pioneers of RASP. A growing body of evidence confirms that RASP provides results similar with open and laser enucleation, improving outcomes with favorable low complication rates.¹⁴ Several reports on RASP have been also made recently in Korea.⁹ RASP has become one of the standards in minimally invasive techniques for large prostates with studies showing improvement in peri-operative outcomes without compromising functional outcomes.^{15,16} Umari et al.¹⁷ performed a comparison of HoLEP and RASP where they reported similar improvements for Qmax, PVR, IPSS, similar operative time, and complication rates. In the present study, a similar therapeutic effect between both methods was also reported. Furthermore, no significant difference was found in the improvement of Qmax, PVR, IPSS, and quality of life. The same pattern was observed in mean specimen weight and operation time. The data reported were similar as the previous study results. This emphasizes the comparable therapeutic effects of both methods.

On the other hand, Zhang et al.¹⁸ reported that patients who underwent HoLEP exhibited shorter mean operative time, catheter removal time, and length of hospital stay. Lower transfusion rates were also favorable in HoLEP. They concluded that in expert hands, HoLEP appears to have a favorable perioperative profile. In the present study, HoLEP provided minimal hemoglobin change, shorter catheterization time, and shorter length of hospital stay. In both techniques, hemostasis is attained through the application of direct energy. However, the endoscopic method allows quick and delicate control of bleeding. In RASP, there is a tendency for rebleeding upon contact with liquid even after prior hemostasis. With regards to hospital stay, the HoLEP group exhibited shorter length of hospital stay. Patients in the HoLEP group were viable for discharge one or two days postoperative, once hematuria has been resolved. On the other hand, the large cystostomy wound in RASP patients requires five to six days of catheterization. Recently, the authors tried to reduce catheterization time but the length of hospital stay remained longer compared to HoLEP.

In the present study, no patient in RASP complained incontinence at 2 months postoperative compared to 15.4% of participants in the HoLEP group. Stress incontinence is often cited as a concerning and under-reported side effect of HoLEP. It is not uncommon (4.9%–12.5%) for patients to experience transient urinary leakage, though most usually recover within one year.^{19,20} Factors associated with post-HoLEP incontinence include diabetes mellitus, longer operation and enucleation time, surgeon's experience, larger prostate size, and higher blood loss.^{21–23} Furthermore, HoLEP

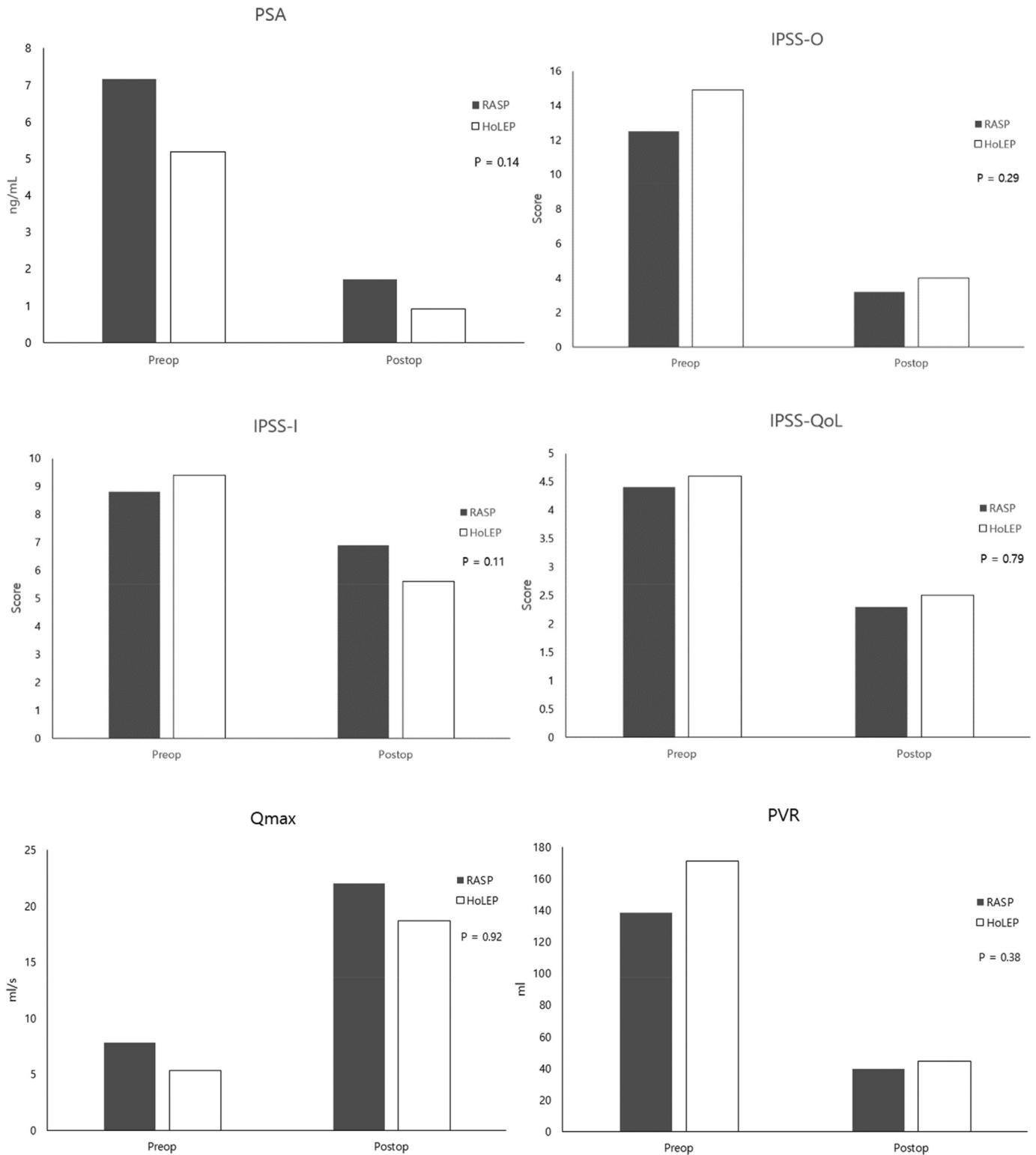


Figure 1. Comparison of change in preoperative to postoperative parameters. RASP, robotic-assisted simple prostatectomy; HoLEP, holmium laser enucleation of the prostate; PSA, prostate specific antigen; IPSS, International Prostatic Symptom Score; QoL, quality of life; Qmax, maximum flow rate; PVR, post-void residual urine.

requires the use of a 26F sheath, making surgery difficult in patients with a small-caliber urethra. This also runs the risk of damaging the urethra. More than anything, the resection of near the external sphincter also might result in incontinence. In contrast, RASP has

the advantage of preserving the urethra and external sphincter during the operation. In RASP removal of the adenoma is performed by pulling it in the opposite direction of the external sphincter. By this technique, it can preserve the external sphincter and tissues

Table 2
Perioperative and postoperative assessment and complications

Parameter	RASP (n = 33)	HoLEP (n = 26)	P value
Time of surgery (minutes, SD)	128.6 (26.3)	140.0 (76.1)	0.42
Resected adenoma weight (g, SD)	49.3 (24.6)	42.2 (22.4)	0.26
Length of stay (days, SD)	7.1 (1.1)	2.5 (0.8)	<0.01
Catheterization time (days, SD)	7.0 (0.9)	1.5 (0.8)	<0.01
Postoperative hemoglobin change (g/dL, SD)	1.8 (1.3)	0.7 (0.9)	<0.01
Blood transfusions, n (%)	0 (0.0)	0 (0.0)	
Modified Clavien classification, n (%)	6 (18.1)	6 (23.0)	0.71
Grade I			
Acute urinary retention	0 (0.0)	1 (3.8)	<0.01
Gross hematuria with clot	2 (6.0)	1 (3.8)	0.56
Grade II			
Urgency	24 (72.7)	13 (56.5)	0.19
Urge incontinence	12 (36.3)	6 (23.0)	0.13
Dysuria	3 (9.1)	0 (0.0)	<0.01
Stress incontinence			
At 2 weeks	3 (9.1)	4 (15.4)	0.45
At 1 month	1 (3.0)	4 (15.4)	0.09
At 2 months	0 (0.0)	4 (15.4)	0.03
Grade IIIb			
Bladder neck contracture	1 (3.0)	0 (0.0)	<0.01

RASP, robotic-assisted simple prostatectomy; HoLEP, holmium laser enucleation of the prostate.

associated with the continence mechanism. Therefore, incontinence after RASP is not a major problem and there are no reports describing incontinence as a complication of RASP.²⁴

One patient in the RASP group developed bladder neck contracture in the present study. This complication was frequently reported in other studies. Autorino et al.¹⁴ in their comparative study reported bladder neck contracture in three out of 487 patients (0.6%) and three out of 843 patients (0.35%) in RASP and laparoscopic simple prostatectomy groups, respectively. On the other hand, Sorokin et al.²⁵ reported bladder neck contracture in two and zero patients among OSP and RASP groups, respectively. In the early experience of RASP, the authors tried making the bladder neck smaller similar to traditional retropubic simple prostatectomy to reduce postoperative hematuria. After increasing the size of the bladder neck, no contracture was noted on RASP.

Finally, there are some considerations about the cost. In our experience, the mean cost of the RASP (\$ 7287) was more expensive than HoLEP (\$ 809). In Korea, national health insurance pays a large part of the costs related to national health care. However, national health insurance did not cover the majority of expenses of robot procedures. Recently, more expensive new technologies such as Aquablation® therapy and Rezum™ water vapor therapy have been introduced.²⁶ RASP may be a more reliable and effective treatment method than other new procedures. As the patient's demand for robotic surgery increases, its use is also expected to increase, and robotic surgery is being converted to benefit insurance coverage like other various countries such as Japan, Hong Kong, and Denmark.²⁷

This study has several limitations. First, this is a retrospective, single-center study that may lead to selection bias. Second, the sample size of the study is relatively small since it is a preliminary. Third, not all prostate adenomas in the study are larger than 80 g. The authors performed HoLEP or RASP on subjects who had massive intravesical prostatic protrusion or concurrent bladder lesion. Fourth, this study included early experience using both techniques. Therefore, it is possible that some confounding factors may persist. Further multicenter large cohort studies are required to confirm our findings.

5. Conclusion

HoLEP and RASP are the most important therapeutic techniques for large BPH. HoLEP is applicable for all sizes of prostate but has a

steep learning curve. In contrast, RASP could provide a similar operating condition to traditional surgery and is relatively easy to learn. Both techniques can produce excellent postoperative outcomes. However, catheter removal time, length of stay, and changes in hemoglobin were more favorable in HoLEP. On the other hand, RASP provided better postoperative incontinence outcomes. These factors must be heavily considered during the selection of surgical method for large prostate.

Authors Contribution

Hye Jin Byun: Project development, Data Collection, Manuscript editing. Byung Hoon Kim: Project development, Data Collection, Manuscript writing.

Conflict of interest

All authors have no conflict of interest to declare.

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