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Robotic-assisted perineal versus transperitoneal radical prostatectomy: A matched-pair analysis

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ABSTRACT

Objective: We compared the outcomes of robotic-assisted radical perineal prostatectomy (r-PRP) versus robotic-assisted transperitoneal laparoscopic radical prostatectomy (RARP).

Material and methods: Between November 2016 and September 2017 in our center, 40 patients underwent r-PRP, and 40 patients underwent RARP. All patients also underwent multiparametric magnetic resonance imaging (mpMRI) to exclude the cases with locally advanced disease. Patients with localized prostate cancer (C–T2N0M0) were included in the study. The exclusion criteria were contraindications for undergoing robotic radical prostatectomy; the Gleason score ≥4+3; extracapsular extension proven on biopsy or suspected on mpMRI; clinical stage ≥T2c; required pelvic lymph dissection according to Partin's normogram; previous radiation therapy; hormonal therapy; any previous prostatic, urethral, or bladder neck surgery; and preoperative urinary incontinence or erectile dysfunction. Patients were placed in the exaggerated lithotomy position with 15° Trendelenburg for r-PRP and 40° Trendelenburg for RARP.

Results: The mean age for the r-PRP and RARP groups were 61.2 (46–73) and 62.2 (50–75) years, respectively. The mean body mass index was significantly higher in the r-PRP group (p=0.02). The mean procedure duration time was 169.4 (100–255) minutes for the r-PRP group and 173.1 (130–210) minutes for the RARP group. The mean console time and anastomosis time were significantly lower for the r-PRP group. The mean estimated blood loss was significantly lower for the r-PRP group (p=0.002). Immediate continence rates in the r-PRP and RARP groups following the urethral catheter removal were 42% and 35% (p=0.30), respectively. Continence rates increased to 94.2% in the r-PRP and 72% in RARP (p=0.001) group at the 6th month, and to 95% in the r-PRP and 85.2% in RARP (p=0.02) group at the 9th month follow-up period. According to the International Index of Erectile Function-5 (IIEF-5), the erectile function rates at the 3-, 6-, and 9-month follow-up in the r-PRP group were 44%, 66%, and 75%, respectively. The rates in the RARP group at the 3-, 6-, and 9-month follow-up were 25%, 42%, and 66% (p=0.001), respectively.

Conclusion: In our experience, r-PRP has acceptable morbidity, excellent surgical and pathological outcomes, and satisfactory oncologic and functional results compared to RARP.

Keywords: Perineal; radical prostatectomy; robotics; transperitoneal.

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Introduction

Robot-assisted transperitoneal laparoscopic radical prostatectomy (RARP) has been used worldwide since its introduction in 2000.[1,2] RARP is commonly performed using the transperitoneal (TP) approach because it offers enough arm distance, a larger working space, and familiar laparoscopic intraperitoneal landmarks.[2] However, the TP approach has several limitations, including potential severe bowel complications. In case of a major prior surgical history, dissection of severe intraabdominal adhesions is necessary.[3] Conventional robotic procedure is comfortable for the surgeon, but the number of ports used in the surgery leads to port scars and complications, such as hernia or hemorrhage.[4] The laparo-endoscopic single site surgery radical prostatectomy method has been described to avoid port site complications which are postoperative pain, hemorrhage, hernia. This technique provides better cosmesis.[5] However, this method is technically more difficult to perform and needs an additional robotic platform, which increases the cost.

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Robot-assisted perineal radical prostatectomy (r-PRP) is a new technique described by Jihad H Kaouk. The authors first performed this technique on a cadaver model and then presented their initial results on four patients.[6] We applied this technique on 15 patients and recently presented our initial results. We demonstrated that this technique can be safely applied in patients without extraprostatic extension.[7] In this technique, the perineal approach is performed below the endopelvic fascia and the bladder neck level, without the bowel involvement. Herein, we compared the outcomes of the r-PRP and RARP procedures.

Material and methods

Between November 2016 and September 2017, a total of 80 patients with low-to-intermediate risk localized prostate cancer, who underwent robotic-assisted radical prostatectomy performed by a single surgeon who had participated in over 1000 robotic-assisted procedures (VT), were included. Our primary surgeon's open perineal prostatectomy (RPP) experience was adequate but not as well as with the robotic-assisted prostatectomy procedures. At the beginning of our learning curve, we have done the operations under the supervision of a surgeon who was experienced in RPP. The inclusion criterion was diagnosed localized prostate cancer (C–T2N0M0). The exclusion criteria were the contraindications for robotic radical prostatectomy; the Gleason score ≥4+3; extracapsular extension proven on biopsy or suspected on multiparametric magnetic resonance imaging; clinical stage ≥T2c; pelvic lymph dissection requirement according to Partin's nomogram; previous abdominal radiation therapy; hormonal therapy; any previous prostatic, urethral, or bladder neck surgery; and having preoperative urinary incontinence or erectile dysfunction.

The study protocols were approved by the medical ethics committee of our hospital. A retrospective matched-pair analysis of the surgical and functional outcomes was performed to compare Group 1 (r-PRP [n=40]) with Group 2 (RARP [n=40]). Comparisons were made according to the following parameters: the mean age, median level of prostate-specific antigen (PSA), biopsy Gleason score, ASA score, and Charlson score (Table 1).

Patients were positioned in the exaggerated lithotomy position with 15° Trendelenburg (Figure 1a) for r-PRP and 40° Trendelenburg for RARP (Figure 1b). Four 8 mm robotic trocars and one 12 mm Versapor Plus V2 assistance trocar were placed intraperitoneally in the RARP group (Figure 2a), and the Da Vinci

Table 1. Demographic and the preoperative data

	r-PRP	RARP	p
Mean age (year-range)	61.2 (46–73)	62.2 (50–75)	0.55
Mean BMI (kg/m^2-range)	29.1 (24–32)	25.6 (24–30)	0.02
Mean PSA (ng/mL-range)	7.35 (3.92–15.6)	7.51 (4.2–14.7)	0.80
Prostate volume (cc-range)	66.3 (25–110)	44.8 (25–70)	0.001
Previous abdominal/Pelvic surgery			
Yes	70%	35%	0.001
ASA score			
1	12%	14%	0.52
2	80%	82%	0.32
3	8%	4%	0.28
Charlson score			
≤2	89%	91%	0.63
>2	11%	9%	
Clinical stage			
T1c	4 (10%)	6 (15%)	0.28
T2a	4 (10%)	5 (12.5%)	0.38
T2b	10 (25%)	13 (32,5%)	0.39
T2c	22 (55%)	16 (40%)	0.33
Gleason Score			
6	26 (65%)	28 (70%)	0.34
3+4	14 (35%)	12 (30%)	0.56

Figure 1. a,b. The exaggerated lithotomy position with 15° Trendelenburg (a). The position with 40° Trendelenburg (b)

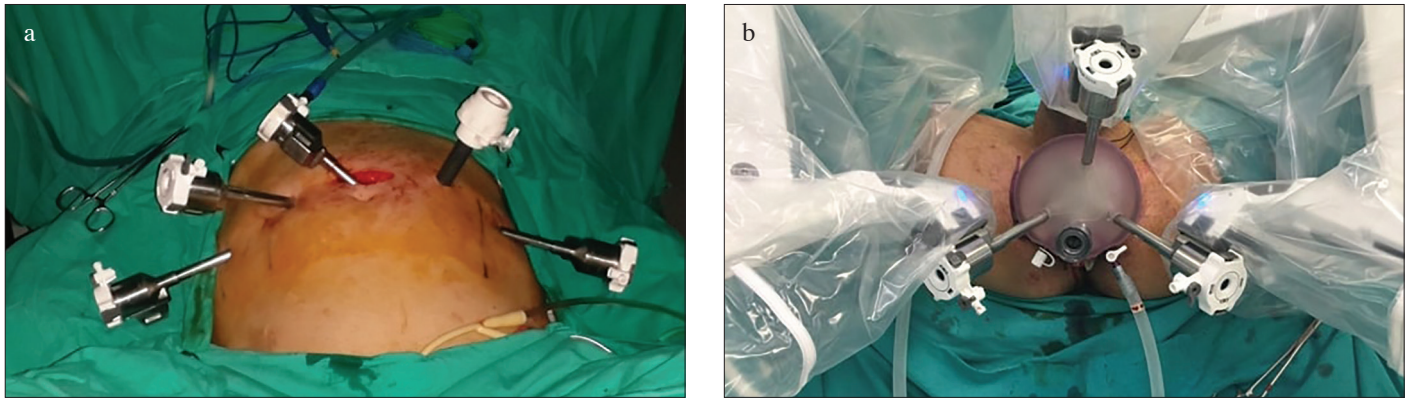

Figure 2. a,b. The trocar placement in RARP (a). The trocar placement in r-PRP (b)

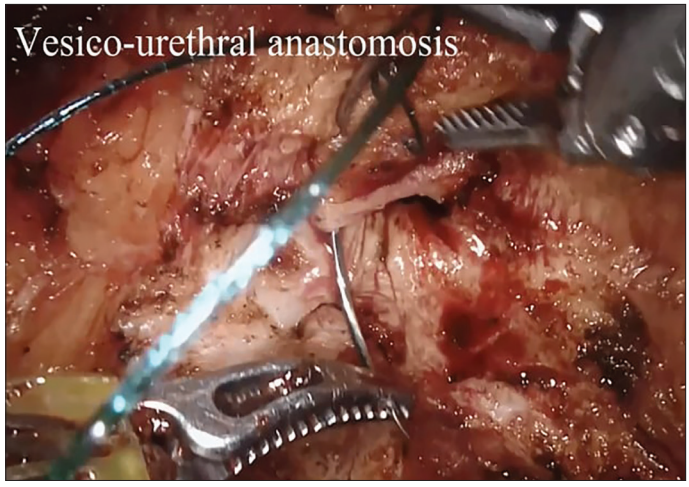

Figure 3. Vesicourethral anastomosis in r-PRP

XI robotic system was docked between the legs. In the r-PRP group, perineal skin was incised, and perineal dissection was performed. Dissection was maintained by approaching the apex of the prostate from the inferior aspect. To place the GelPOINT (Applied Medical, Rancho Santa Margarita, CA, USA), the subcutaneous tissue lying under the incision borders was dissected deeply over the superficial perineal fascia. Before the GelPOINT was inserted into the perineal incision, the trocars were placed onto it. For the camera, an 8 mm robotic trocar was placed at 12 o'clock, and the other two robotic 8 mm trocars were placed at 5 and 7 o'clock on the GelPOINT (Figure 2b). For the assistance, a 10 mm trocar was placed at 6 o'clock, and the Da Vinci XI robotic system was docked between the legs. This operative technique has been previously described in detail in the literature.[7] In the r-PRP group, the dissected perineal area was insufflated with carbondioxide gas at an average pressure of 10 mmHg, while the abdomen was insufflated with the same gas at an average pressure of 12 mmHg in the RARP group. Taking the Partin's nomogram results into consideration, the pelvic lymph node dissection was not performed in either of the groups. The nerve-sparing surgery technique was employed in both the groups. The Van Velthoven technique was performed for the vesicourethral anastomosis for the RARP group, and a modified anastomosis was performed for the r-PRP group (Figure 3).

All specimens were evaluated according to the Gleason score, and pathological staging was based on the TNM 2002 classification. A positive surgical margin (PSM) was defined as the

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presence of tumor at the inked margin. Perioperative complications were recorded according to the modification of the Clavien–Dindo system.[8] The definition of continence was based on the response to the item selected to reflect the range of incontinence severity by asking the following question: ''How many pads per day did you usually use to control the leakage?'' Continence was defined as the use of no pads or only a safety pad. Potency was determined from patients' reports and the IIEF-5 form. Potency was defined as the ability to achieve and maintain satisfactory erection firm enough for a sexual intercourse with or without the use of phosphodiesterase type-5 inhibitors.

Statistical analysis

Continuous data were presented as the mean and standard deviation, and categorical variables were shown as a percentage. The numeric parameters of both the groups were compared using Student's t-test or the Mann–Whitney U test. For the comparison of nominal data, the chi-squared test was used. A p-value of 0.05 was considered statistically significant.

Results

The mean age for the r-PRP and RARP group was 61.2 (46–73) and 62.2 (50–75) years respectively. The mean body mass index (BMI) was significantly higher in the r-PRP group (p=0.02). There was no significant difference between the two groups with regard to preoperative mean PSA levels, ASA scores, and the Charlson Comorbidity Index scores. There was no significant difference detected between the two groups for preoperative clinical stage and Gleason scores.

The mean operation duration time was 169.4 (100–255) minutes for the r-PRP group and 173.1 (130–210) minutes for the RARP group. The mean console time and anastomosis time was significantly shorter in the r-PRP group. The mean estimated blood loss was significantly lower in the r-PRP group (p=0.002). The mean hospitalization time was significantly shorter for the r-PRP group and detected as 1.83 (1–3) days for the r-PRP and 3.9 (2–7) days for the RARP group.

Wound infection was observed in one patient in the r-PRP group, and it was treated with conservation. In the RARP group, four patients had postoperative paralytic ileus and were treated conservatively. None of patients developed ileus in the r-PRP group. The PSM rates were similar for both groups.

Immediate continence rates in the r-PRP and RARP groups following the urethral catheter removal were 42% and 35% (p=0.30), respectively. Continence rates increased to 94.2% in the r-PRP and 72% in the RARP (p=0.001) group at the 6th month, and to 95% in the r-PRP and 85.2% in the RARP (p=0.02) group at the 9th month follow-up period.

Potency was preserved only in those patients who could achieve an erection firm enough for sexual intercourse prior to the operation (IIEF-5>21). According to the IIEF-5, the erectile function rates at the 3-, 6-, and 9-month follow-up in the r-PRP group were 44%, 66%, and 75%, respectively. The rates in the RARP group at the 3-, 6-, and 9-month follow-up were 25%, 42%, and 66% (p=0.001), respectively.

Preoperative, peroperative, and postoperative findings are summarized in Tables 1–3.

Discussion

The biggest difference between the two techniques is that r-PRP is performed via a different anatomical approach, and this is what strictly distinguishes it from RARP. There is no need to dissect bowel adhesions in patients who underwent prior major abdominal surgery. In this way, it is possible to preserve the anatomy and physiology of the prostate cancer patients who have previously undergone kidney transplantation, intestinal by-pass surgery, or those who have received abdominal radiotherapy.

An important issue in patient selection is the patient's BMI, and a previous major abdominal as well as pelvic surgical history. Wolf et al.[9] reported that various complications may occur at a rate of 0.05%–2.8% during trocar placement and that entry-related complications were rare, but that the mortality rate was 13%. Leung et al.[10] reported that the perineal approach was safe in obese patients because only perineal dissection was performed in the radical prostatectomy technique. Radical prostatectomy can be easily performed in obese patients by applying the r-PRP technique. Magnified vision and dexterity are the advantages of the robotic surgical system when performing this procedure in a narrow area.

Table 2. Peroperative data

	r-PRP	RARP	p
Mean console time (minute-range)	103.4 (55–160)	135.6 (110–175)	0.001
Mean estimated blood loss (cc-range)	65.2 (40–145)	81.6 (40–165)	0.002
Anostomosis time (minute-range)	12.4 (10–18)	16.4 (14–22)	0.001

Table 3. Postoperative data

	r-PRP	RARP	p
Mean hospitalization (day-range)	1.83 (1–3)	3.9 (2–7)	0.001
Mean bladder catheterization time (day-range)	8.42 (5–12)	8.64 (7–10)	0.99
Complications			
Wound infection	1 patient	no	
Ileus	No	4 patients	
Transfusion required bleeding	No	1 patient	
Abdominal wall hemorrhage at trocar placement	0	1 patient	
Urinary leakage	1 patient	3 patients	
Positive surgical margin	4 (10%)	5 (12.5%)	0.65
T2a	0	1 (2.5%)	
T2b	1 (2.5%)	2 (5%)	
T2c	3 (7.5%)	2 (5%)	
Upgraded pathology	4 (10%)	3 (7.5%)	0.44
Downgraded pathology	2 (5%)	1 (2.5%)	0.47
Immediate continence rate	42%	35%	0.30
Continence rate 3rd months	94%	63%	0.001
Continence rate 6th months	94.2%	72%	0.001
Continence rate 9th months	95%	85.2%	0.02
Erectile function rate 3rd months	44%	25%	0.001
Erectile function rate 6th months	66%	42%	0.001
Erectile function rate 9th months	75%	66%	0.001

The prostate volume is one of the factors that may put the surgeon into a difficult situation during surgery. Prostates with larger volumes may be easier to operate because of a wider operation field in RARP; however, when large prostates are operated via the transabdominal approach, the bladder is more mobilized, and both endopelvic fascia are incised more deeply.[11] This means there may be more damage to the hypogastric plexus, and complications may arise in the dissection of apex. The maximum volume of the prostate resected in the r-PRP group was 140 cc in our series. Eden[12] have reported that prostates with a volume of up to 60 cc could be safely operated in RPP. It is very difficult to notice and resect the middle lobe by the open method. In the r-PRP technique, high-volume prostates could be safely removed, and the middle lobe traction suture is useful to tackle with the prostates with a median lobe. The Da Vinci XI robotic system offers a more comfortable surgical procedure when working in the narrow and deep operation fields compared to RPP.[7] Also, surgeon's experience is one of the most important factors when working with middle lobes and bigger prostates.[7]

Weber et al.[13] reported that due to the position of exaggerated Trendelenburg and an increased intraabdominal pressure, an elevation of the venous pressure in the eye was responsible for the development of ischemic optic neuropathy. Complications related to carbon dioxide insufflation were reported in 2%–4% of patients, which include cardiopulmonary system disorders, hypercarbia and pulmonary acidosis, and the most feared, but rare, pulmonary embolism.[14] In our study, there were no complications related to the position or abdominal insufflation in the RARP group. This is due to the fact that patient selection was appropriate and that surgery was completed as soon as possible. In the r-PRP technique, the surgical procedure was performed in the 15° Trendelenburg position, and the area dissected up to the recto-urethral muscles was insufflated with carbon dioxide. This technique is more compatible with physiological conditions.

The duration of the procedure is another important factor to be considered in radical prostatectomy. Rozet et al.[15] reported an average of 166 minutes of the main procedure time in robotic radical prostatectomy. We found out that the console time in the

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r-PRP group was significantly shorter. However, the perineal dissection performed before the robotic stage in this group affects the entire procedure time. The mean duration of the procedure in both the groups was found to match the literature. Unlike the other group, the bladder was not dropped by peritoneal dissection, and the endopelvic fascia was not incised in the r-PRP group; therefore, no reconstructive procedures were performed. We think that these differences are the most important factors that shorten the procedure duration in r-PRP.

One of the most important factors that affect the postoperative course and early recovery is the intraoperative blood loss. Willis et al.[16] have reported an average blood loss of 148 cc in their robotic radical prostatectomy series. In our study, the blood loss in the r-PRP group was lower than in the RARP group, and for the following possible reasons: 1) In the r-PRP group, the venous system was exposed to pressure, and the operation was performed under positive pressure in a narrow field; 2) vascular structures were well visible with optical magnification, and a more effective bleeding control was achieved by the surgeon; 3) the Santorini venous plexus was out of the resection area in the r-PRP group; 4) the most likely cause of blood loss in RARP is the method employed to release and ligate the deep dorsal venous complex, but bleeding control was not necessary in r-PRP. The abdominal wall hemorrhage during RARP is another postoperative complication, related to robotic arms, which may damage the inferior epigastric veins, which is again avoided in the r-PRP technique.[4]

Postoperative ileus is caused by many factors, the most important of which is the preferred surgical technique. Christensen et al.[17] divided their patients into two groups and performed robotic radical prostatectomy by applying the 12 mmHg pressure in one group and 15 mmHg in the other. Postoperative ileus was detected in 4% of the low pressure group, whereas it was detected in 8% of the other group.

In our study, ileus was not observed in the r-PRP group. However, spontaneous regression of ileus was detected in 10% of the RARP group. This is one of the important factors that affects duration of hospitalization and recovery. Another problem affecting hospitalization stay are postoperative complications, one of which is urinary leakage. Spector et al.[18] have reported postoperative urinary leakage at a rate of 4.7% in their robotic radical prostatectomy series. In our study, the urinary leakage rate in the r-PRP group was lower (2.5%) than the rates stated in the literature. The rate was 7.5% in the RARP group, which was three times higher compared to r-PRP. One of the great advantages of the r-PRP technique is that the operation area can be viewed from all angles while anostomosis is performed, and the bladder neck incision can be made under direct vision, which makes it possible for the surgeon to perform the operation in a better way.

In a study by Park et al.[19], the mean hospitalization time of patients who had undergone robotic radical prostatectomy was reported as 6 days. In our study, an early discharge rate in the r-PRP group was higher than that in the RARP group. The drain tube was removed within the first or second day, and patients were discharged within a mean period of 1.83±0.6 days. We think that the perineal approach causes less postoperative pain. The absence of abdominal involvement is an important factor that makes an early return of bowel function possible. Early mobilization of the patient might also facilitate early discharge. In addition, we think that a small perineal incision has a positive psychological effect on patients.

There were no significant differences in terms of oncological results between the groups. One of the most important indicators of the applicability of the radical prostatectomy technique is the surgical margin positivity rate. Tozawa et al.[20] reported a PSM rate of 26% in their robotic radical prostatectomy series.

In our study, the PSM rate was 10% in the r-PRP group and 12.5% in the RARP group. There was no significant difference between the two groups, and the rates achieved were lower than those stated in the literature. In the RARP group, resection of a larger area could be performed via the transperitoneal approach, and the PSM rate was found to be the same as that of the r-PRP group, indicating that the r-PRP technique can be performed safely.

The presence of urinary incontinence and erectile dysfunction after RP can significantly impact the patient quality of life. In their nerve-sparing robotic radical prostatectomy series, Asimakopoulos et al.[21] found that continence rates were 69% at the 3-month follow-up, 88% at 6 months, and 94% at 12 months. Hakimi et al.[22] stated that their continence rates at 3-, 6-, and 12-month follow-ups were 54%, 65%, and 89%, respectively. Porpiglia et al.[23] reported that the erection rates in their robotic radical prostatectomy series at the 3-, 6-, and 12-month follow-up were 60%, 65%, and 80%, respectively. The functional outcomes in our RARP group were similar compared to those in the literature, while the continence and potency rates in the p-PRP group were higher.

In our study, the recovery from incontinence in the r-PRP group was faster. The continence rates in this group were found to be significantly higher than those in the RARP group and in the literature. Compared to the RARP group and the literature, the erection rates in our r-PRP series were found to be higher, especially in the late period. One of the biggest differences between the two techniques employed in our study was the surgical approach adopted while intervening these anatomical structures. Endopelvic fascia in the r-PRP group was not incised. The branches of the hypogastric plexus, which contribute to conti-

nence and erectile function, might be severely damaged in the RARP group. In the r-PRP group, the urethra was incised by approaching from the below, and dissection was continued between the neurovascular bundle and the prostate without cutting the neurovascular bundle at 2 and 10 o'clock. These structures remained intact, and the anatomical integrity was not disturbed. The preservation of the immobile structure of the dorsal side of the urethra and bladder fulfill the need of anterior and posterior reconstruction. The p-PRP technique offers excellent visibility for the urethrovesical anostomosis. Even though anostomosis is performed in a narrow field, this technique provides an excellent anatomical exposure. This is the reason why vesicourethral anastomosis can be performed safely and easily. We think that high continence rates at the early postoperative period might be associated with the anostomosis performed via the perineal approach.

The study has some limitations: the small patient population, its retrospective nature, lack of randomization, and limited follow-up. Furthermore, when we started to apply the r-PRP technique first, we were not able to perform lymphadenectomy, and thus we excluded patients who required lymphadenectomy. Although all the operations were performed by a single surgeon, r-PRP is a new technique, and we do not have enough knowledge about the learning curves. Recently, we reported for the first time, to the best of our knowledge, the novel *in vivo* Tugcu Bakirkoy robotic perineal radical prostatectomy technique. We have demonstrated that dissection of the robotic pelvic lymph node with the perineal approach can be performed safely and effectively.[24]

In conclusion, to the best of our knowledge, this is the first study to compare the outcomes of r-PRP and RARP performed by the same surgeon. Various problems that may arise in the RARP method can easily be overcome without any complications if the r-PRP technique is preferred. Further randomized controlled studies with a larger number of patients are needed to compare these two techniques.

Ethics Committee Approval: Ethics committee approval was received for this study from the ethics committee of Health Science University Bakirkoy Dr. Sadi Konuk Training and Research Hospital (2017/42).

Informed Consent: Written informed consent was obtained from patients who participated in this study.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept – S.Ş., O.A., İ.Y.; Design – İ.Y., A.Ş., O.A.; Supervision – O.A., V.T., A.İ.T.; Resources – İ.Y., M.G.Y., S.Ş.; Materials – M.G.Y., S.Ş., V.T.; Data Collection and/or Processing – İ.Y., M.G.Y., A.Ş.; Analysis and/or Interpretation – A.Ş., S.Ş.; Literature Search – İ.Y., M.G.Y., O.A.; Writing Manuscript – İ.Y., A.Ş., V.T.; Critical Review – V.T., A.İ.T.

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