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ARTICLE

Prostatic morcellation after HoLEP Enucleation: efficiency and safety of Storz DrillCut vs. Jena Surgical Multicut Solo

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Backgrounds: *Holmium laser enucleation of the prostate (HoLEP) is a widely accepted technique for treating benign prostatic hyperplasia (BPH). Developed in the 1990s, its safety and efficiency have improved with adenoma morcellation. Multiple morcellation devices exist, with oscillatory systems offering higher efficiency and safety. Notable among these are the DrillCut Storz™ (DC) and the Multicut SOLO Jena Surgical™ (MC). Currently, evidence on the efficiency of MC is limited, and no comparative analysis exists between oscillatory morcellators. The objective of this study is to compare the morcellation efficiency (g/min) of the DC and the MC. A secondary objective was to assess intraoperative injury rates associated with both morcellators.*

Methods: *Prospective, observational, non-randomised cohort that included patients over 40 years old with a surgical indication for BPH, recruited from the Urology Department at Hospital Italiano de Buenos Aires (October 2023–June 2024). Dependent variables analyzed were morcellation efficiency and complications whereas independent variables were age, surgical time, PSA, prostate volume, PSA density, prior medication, urinary catheter use, and prostate cancer findings.*

Results: *A total of 264 patients were included (mean age: 70.1 years). The DC group had 98 patients whilst the MC group had 165 patients. Average morcellation time was 7.3 min (DC) and 9.1 min (MC) ($p = 0.110$). Mean adenoma weight morcellated was 49.9 g (DC) vs. 69.4 g (MC) ($p < 0.001$). Efficiency (g/min) was 10.5 (MC) vs. 8.3 (DC) ($p < 0.001$). Average surgical time was 84.4 min (DC) vs. 82 min (MC) ($p = 0.541$). Four intraoperative complications occurred in the DC group (4.1% vs. 0%; $p = 0.005$). All were minor bladder lacerations without postoperative management changes.*

Conclusions: *The MC demonstrated superior efficiency and a lower rate of complications. However, incidence of complications was low in both groups, supporting the safety of both devices.*

Key Words: HoLEP, morcellation, efficiency, safety, complications

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Introduction

Holmium Laser Enucleation of the Prostate (HoLEP) is a currently accepted and widely used technique for the treatment of benign prostatic hyperplasia (BPH). This technique can be applied to prostates of any size and patients of various age groups.[1] HoLEP was developed in the 1990s as an evolution of Holmium Laser Ablation (HoLAP) and Holmium

Laser Resection of the Prostate (HoLRP). The addition of adenoma morcellation has made HoLEP a faster, more efficient, and safer procedure.[2]

Currently, green laser, thulium laser, and bipolar energy are other options for anatomical endoscopic enucleation of the prostate (AEEP). There is evidence showing the superiority of AEEP over transurethral resection of the prostate (TURP) in clinical parameters, reducing hospitalization and postoperative haematuria.[3,4]

HoLEP involves two steps: the enucleation of the prostatic adenoma and morcellation. Since 1996, morcellators have continually evolved. There are now three popular types of morcellators, which differ in their cutting blade movement systems: oscillating and reciprocating, and in their blade design, with or without teeth.[5,6]

The Piranha Wolf™ (Piranha) is an oscillating morcellator with reusable toothed blades that move from side to side. The tip of this morcellator is blunt and does not move. The collection chamber has limited capacity and must be changed when full, resulting in intermittent interruptions of the procedure. The VersaCut Boston Scientific™ (VersaCut) features a reciprocating system with bladeless cutting. Its blade is reusable and extends beyond the tip of the instrument. The DrillCut Storz™ is an oscillating morcellator with a straight, sterilizable blade, a droplet-shaped cutting aperture, a serrated outer window, and a doubly fenestrated and serrated inner window.

These morcellators are introduced through a nephroscope of 26, 24, or 22 French with continuous saline irrigation flow to maintain bladder distension during morcellation and reduce the risk of inadvertent bladder injury.[7]

For currently available morcellators, studies show a slight superiority of the Piranha™ and DrillCut™ compared to the VersaCut™ in terms of morcellation efficiency (6.5, 5.3, and 3.8 g/min, respectively) and intraoperative complications, while the VersaCut™ shows a lower rate of morcellator malfunction.[4,5,8,9]

More recently, the Multicut SOLO Jena Surgical™ morcellator has been introduced to the market. This device features an oscillating system with reusable toothed blades and a bevelled interior. There is limited evidence available regarding its efficiency.

While several morcellators are currently available, information on the three most popular devices is well-documented. However, there is a notable lack of evidence comparing the MC and the DC in terms of safety and efficacy. Given that our institution, along with others in the region, has access to these devices, it is essential to conduct this study to generate valuable data that can enhance surgical outcomes and inform clinical practice.

The primary objective of this study is to evaluate and compare the efficiency of morcellation, measured in grams per minute, between the DC and the MC morcellators. Furthermore, the study aims to assess the safety profile of these devices by identifying the incidence of intraoperative bladder injuries associated with their use. By addressing these objectives, this research seeks to provide a comprehensive understanding of the performance and risks of these two devices, contributing to more informed decision-making in surgical settings.

Methods

Prospective, observational, non-randomised cohort. Patients from the Urology Department of the Hospital Italiano de Buenos Aires were recruited from 2 October 2023, to 7 June 2024. Only patients operated on by specialized surgeons in HoLEP technique were included. Each of the five surgeons that carried out these surgeries had performed more than 1000 HoLEP procedures using both of the morcellation devices analyzed in this study.

Informed consent was obtained from the patients, outlining the study objectives and clarifying that both morcellators are currently approved and do not impact surgical outcomes.

Inclusion criteria:

1. Male patients aged ≥40 years
2. Diagnosis of BPH with surgical indication
3. Patients who underwent HoLEP at Hospital Italiano de Buenos Aires
4. Surgical procedures performed between 2 October 2023 and 7 June 2024.

Exclusion criteria:

1. History of previous prostatic surgery for benign prostatic hyperplasia.
2. Intraoperative modification of morcellator settings, specifically changes in rotational speed (revolutions per minute) and aspiration/suction power.
3. Occurrence of "beach ball" during morcellation, leading to ineffective tissue fragmentation.

A total of 63 patients were excluded based on the predefined exclusion criteria. Of these, 29 patients were excluded due to a history of previous prostatic surgery for benign prostatic hyperplasia. Twenty-three patients were excluded because of the occurrence of the "beach ball" effect during morcellation. The remaining 11 patients were excluded due to intraoperative modifications of morcellator settings.

The main variables we measure in this study include morcellation efficiency, which is defined as the grams of prostate tissue morcellated per minute (g/min). This measurement was obtained by having the operating surgeon notify a timekeeper at both the start and end of the morcellation process. Additionally, morcellation complications were assessed based on the occurrence of bladder lacerations during the morcellation phase of the surgical procedure.

The demographic variables considered include the patient's age, recorded in years, and the type of morcellator used, distinguishing between the DC and the MC. One of the variables collected was total surgical time, calculated from the initiation of anaheesthesia to the placement of the Foley catheter. Prostate-specific antigen (PSA) levels, measured in ng/mL within the year prior to surgery, PSA density, expressed in ng/mL/cc and prostate volume, determined via transabdominal ultrasound in cubic centimeters, were also other variables taken into consideration. Furthermore, preoperative medication use, specifically 5-alpha reductase inhibitors (5-ARI) and alpha-blockers (AB), was noted, with prior usage listed separately in a table. Other variables, such as the diagnosis of prostate cancer (PC) based on pathological anatomy, were also considered as part of the analysis.

Surgical Technique: The HoLEP procedure was performed in the operating room of the Hospital Italiano de Buenos Aires. The technique involves the anatomical dissection of the prostatic adenoma while preserving the prostatic capsule. It was carried out using a 120 W holmium laser generator (Lumenis Pulse™ P120H, Yokneam, Israel) with a reusable 550 nm quartz fibre (SlimLine™ 550, Lumenis Inc.), and through a modified continuous flow resectoscope of 26 French (Fr). Enucleation was performed retrogradely using the en-bloc technique with saline solution. In cases requiring meatal calibration, Benique dilators were used. A rigid nephroscope (Figure 1) with a 5 mm working channel was employed to introduce the tissue morcellator at the end of the procedure using continuous irrigation. All patients adhered to the technique described.

The type of morcellator used during the procedure depended on its availability. When the DC morcellator was used, the device was set at 1600 revolutions per minute, while the MC was set to 2500 revolutions per minute and 3 Hz of oscillation. Both of these are the standard recommended settings by each manufacturer (Figures 2–4).

FIGURE 1. Rigid nephroscope

FIGURE 2. DrillCut morcellator

Below: DrillCut Storz™

After haemostasis, a 22 Fr triple-lumen bladder catheter with continuous bladder irrigation was placed for the first 48 h postoperative. At the end of the surgery, the resected tissue was weighed (dry weight) on the operating room scale.

This study was approved by the Ethics Committee of the Hospital Italiano de Buenos Aires (CEPI 11247).

Statistical Analysis. Sample Size: To detect a difference in means we calculated sample size based on literature. According to this, an estimated mean

FIGURE 3. MultiCut morcellator

FIGURE 4. Above: Multicut SOLO Jena Surgical™

efficiency for the DC was 5.3 g/min (SD: 0.9)[8,9] and for the MC was 6.95 (SD: 4.9)[10] With these parameters, with a two-sided type one error of 0.05, power of 80%, at least 72 patients per group were estimated to include. We intend to include more (30%) for detecting small differences.

Continuous variables are described as mean and standard deviation (SD). Categorical variables are expressed as percentages. Student's *t*-test or Mann-Whitney test was used for continuous variables, and Chi-squared or Fisher's exact test for categorical variables, provided assumptions for each test were met. Univariable and multivariable models for efficiency were calculated by linear regression. A *p*-value of less than 0.05 was considered significant. The software used was SPSS 22.0™ (IBM Corp, New York, NY, USA).

Results

A total of 264 patients were evaluated, with 98 undergoing surgery with the DC morcellator and 165 with the MC morcellator. No statistically significant differences were recorded for any preoperative demographic or pathological variables between the groups, except for pre-surgical prostate volume (Table 1).

Regarding intraoperative data, the MC group showed higher morcellation efficiency compared to the DC group. On average, the MC group was 2.2 g/min more efficient than the DC group. No significant differences were found in morcellation time and total surgical time. The morcellated weight was higher in the MC group (Table 2). Unadjusted coefficient at univariable linear regression shows a mean efficiency change of −2.2 g/min (95% CI [−3.5, −0.8]; $p < 0.002$) from MC group to DC group. After adjustment for morcellated prostate weight, the association between morcellator type and morcellation efficiency remained barely unchanged (−2.4 g/min 95% CI [−3.7, −1.1]; $p < 0.001$). Interaction between the two variables was tested without statistical significance showing consistent effect.

The DC group recorded a higher incidence of intraoperative bladder laceration (4.1% in DC group vs. 0% in MC group; $p = 0.005$). The management of these 4 patients did not differ from those in which the bladder was not injured. No patient required ureteral stent placement or bladder repair. All patients had an indwelling urinary catheter for 48 h, as per routine practice, except for one patient in whom the catheter was left in place for 7 days. These data suggest that the MC group demonstrated greater safety regarding the procedure, although the incidence in both groups was low.

Discussion

The HoLEP surgery marked a paradigm shift in the surgical management of BPH, even for cases of symptomatic recurrence. Studies have shown that compared to other treatment modalities for BPH, HoLEP surgery is safer and more effective,[1,2,3,11] with benefits such as shorter postoperative hospital stay[2] and prostate reoperation rate between 1%–3.3%.[2,12] This has led to increasing use of this technique for surgical resolution of lower urinary tract symptoms (LUTS). Having appropriate surgical equipment facilitates better clinical and symptomatic outcomes.

Adenoma morcellation is a critical step in HoLEP, which can extend surgical time depending on factors such as the amount of prostatic tissue, PSA density,

TABLE 1. **Preoperative demographic and pathological data**

Variable	Total n = 264	DrillCut n = 98	MultiCut SOLO n = 165	*p*
Age, years (SD)	70.1 (8.6)	70.1 (9.1)	70.1 (8.2)	0.996
Prostate volume, cc (SD)	114.3 (54.7)	99.1 (51.7)	123.7 (54.6)	0.001
PSA, ng/mL (SD)	6.70 (6.018)	6.1 (5.2)	7.1 (6.5)	0.170
PSA density, ng/mL/cc (SD)	0.074 (0.19)	0.066 (0.05)	0.079 (0.24)	0.531
AB, % (n)	75 (198)	69.4 (68)	78.3 (130)	0.106
Ia5R, % (n)	17 (45)	13.3 (13)	19.3 (32)	0.209
Previous FC, % (n)	21.6 (57)	18.4 (18)	23.5 (39)	0.328
PC finding, % (n)	6.8 (18)	7.1 (7)	6.6 (11)	0.872

Note. PSA: Prostate specific antigen. AB: alpha blockers. Ia5R: inhibitors 5 alpha reductase. SD: standard deviation. FC: Foley catheter. PC: Prostate cancer.

TABLE 2. **Intraoperative results**

Variable	Total (264)	DrillCut (98)	MultiCut SOLO (165)	*p*
Morcellation time, min (SD)	8.4 (8.9)	7.3 (8.6)	9.1 (8.9)	0.110
Morcellated weight, g (SD)	62.1 (44.3)	49.9 (43.2)	69.4 (43.5)	0.001
Efficiency, g/min (SD)	9.7 (5.4)	8.3 (3.4)	10.5 (6.2)	0.001
Surgical time, min (SD)	82.9 (31.4)	84.4 (27.6)	82 (33.4)	0.541

Note. SD: standard deviation.

the presence of prostatic calcifications and the surgeon's learning curve. This also has the potential risk of serious complications, such as bladder laceration, which could extend total surgical time and impact patient recovery. Nonetheless, there is limited literature on the effectiveness of morcellation,[9] and there are no adequate reports on the learning curve for the morcellation stage.[9] In fact, McAdams et al. emphasized that there is no established learning curve for oscillating morcellators.[7] The limited data available emphasize that morcellation proficiency is achieved relatively early in mid-sized glands, and morcellation efficiency declined as gland size increased, with the largest decrease in >150 cc prostates.[13]

Over the years, various morcellator alternatives have appeared on the market, Current evidence places oscillating morcellators above reciprocating morcellators in terms of efficiency.[4,5,7–9] Our results reveal greater efficiency of the MC compared to the DC. Our center performs approximately 700 HoLEP surgeries annually since the year 2010, carried out by experts. We use irrigation at a height of 2 m with a four-channel irrigation entry, optimizing visibility and safety during the procedure. Both groups showed efficiency above the estimated mean in previous studies, not only compared to other devices such as the Piranha™ and VersaCut™ but also against the reported mean for the DrillCut™.[4,5,7,8,9,12] These results offer significant benefits by reducing surgical times, which is advantageous both economically and in terms of patient risk, as longer surgeries are associated with increased adverse effects and complications, such as greater blood loss or higher rates of postoperative infections.[13,14]

"Beach ball effect" is the effect given when the enucleated tissue has hard nodules resistant to morcellation.[15] These nodules are commonly round in shape, leading to their having been named "beach balls" (BBs) are still reported in up to 13.4% of the procedures, and there were differences with the efficacy between morcellators analyzed.[16] As this phenomenon depends on the tissue characteristics, mainly fibrotic fragments, the incidence of auxiliary procedures tends to increase operating time[9,17] even though surprisingly, Herzberg et al. showed the enucleation rate (g/min) and enucleated tissue weight (g) increase in the presence of BBs.[15] The authors associated that phenomena with larger prostates and consequently with a higher amount of removed tissue as both morcellation and enucleation; as efficiency increases with prostate volume, and beach balls tend to appear in larger prostates.[18,19] We excluded from our analysis patients with presence of BBs to compare both oscillatory morcellators efficiency with similar adenoma characteristics. All currently available devices offer a high degree of safety, as the incidence of bladder wall injuries is low regardless of the device used[4,5] and our results align with the current literature.[20,21] The MC group did not report any cases of bladder lacerations, making it one of the safest devices on the market. The bladder laceration rate in the DC group was also low compared to the literature. For example, Ibrahim et al. reported a 2.4% complication rate[8] with same device. Moreover, the patients with this complication in the DC group experienced no postoperative issues such as prolonged catheterization, haematuria, or the need for urinary tract diversion. These lacerations were all partial thick, and all of them could receive continuous bladder irrigation, nevertheless.

Strengths of this study include a considerable sample size, providing greater statistical significance to the results. Both patient groups were balanced regarding the independent variables analyzed. For example, although evidence is still controversial, some authors suggest that preoperative use of 5-ARI may cause prostatic fibrosis, potentially hindering the morcellation process and increasing its duration.[14,22]

Similarly, the presence of a preoperative bladder catheter or factors such as prostate volume or PSA density might affect morcellation time, either by causing increased intraoperative bleeding or technical difficulties with the morcellator. There were no differences between both groups regarding these variables, thus reducing the likelihood of confounding variables affecting the validity of the results.

Another variable consistent with available literature is incidental pathological findings of prostate cancer.[8,22] In our study, this was found in 6.8% of cases. The difference between groups was not significant, further balancing the populations compared.

Limitations of this study include its non-randomised design. Due to having only one device from each manufacturer, randomisation of patients prior to surgery was logistically challenging. The availability of each morcellator was determined by the fact that each device is allocated to a specific operating room and is not available for transfer. This is why there is a difference in the sample size of each group, since more prostate enucleations were performed in the operating room where the MultiCut morcellator is. Additionally, the availability of morcellation equipment limited our ability to compare the MC with other devices available on the market, such as the Piranha™ and VersaCut™.

Another factor that may have impacted efficiency results is the difficulty in accessing these devices in our region, leading to the use of blades in multiple patients and consequently a decrease in morcellation efficiency.

This last point, however, could be considered an opportunity for future research to analyze morcellation efficiency in relation to cumulative use. This could help extrapolate the ideal performance of each device based on surgical practice, as currently, only manufacturer-reported values are available.

It is evident that the advent of HoLEP marked a significant advancement in the management of BPH. The introduction of new materials and/or devices to facilitate surgical procedures and reduce patient risk is highly valuable. This study provides relevant information for choosing a morcellation device for surgical procedures, as there was limited comparative information on the MC relative to other previously established devices on the market.

Conclusion

The Multicut SOLO™ demonstrated greater efficiency (g/min) compared to the DrillCut™. Although the complication rates were very low, the Multicut SOLO™ demonstrated a slight safety advantage.

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Author Contributions

Conceptualization: Mariano Sebastián González, Ignacio Tobia, Jonatan Reyes Olivera, Lucas Bergadá; Methodology: Mariano Sebastián González, Ignacio Tobia, Jonatan Reyes Olivera, Lucas Bergadá; Investigation (Surgical Procedures): Mariano

Sebastián González, Federico Ignacio Tirapegui, Diego Santillán, Christian Cristallo, Guillermo Montelli Yanzi; Data Curation: Lucas Bergadá, Jonatan Reyes Olivera, José Ramos, Melissa Segura; Formal Analysis: Ignacio Tobia, Lucas Bergadá, Jonatan Reyes Olivera; Writing—Original Draft: Lucas Bergadá; Writing—Review & Editing: All authors. All authors reviewed and approved the final version of the manuscript.

Availability of Data and Materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Ethics Approval

This study was approved by the Ethics Committee of the Hospital Italiano de Buenos Aires (CEPI 11247). Informed consent was obtained from the patients.

Conflicts of Interest

One of the authors of this study, Mariano Sebastián González, is a preceptor for both Storz™ and Jena Surgical™.

Abbreviations

HoLEP	Holmium Laser Enucleation of the Prostate
HoLAP	Holmium Laser Ablation
HoLRP	Holmium Laser Resection of the Prostate
EPE	Endoscopic prostate enucleation
TURP	Transurethral resection of the prostate
BPH	Benign prostatic hyperplasia
DC	DrillCut Storz
MC	Multicut SOLO Jena Surgical
PSA	Prostate-specific antigen
5-ARI	5-alpha reductase inhibitors
AB	Alpha-blockers
PC	Prostate cancer
Fr	French
CEPI	Ethics Committee of the Hospital Italiano de Buenos Aires
SD	Standard deviation
BBs	Beach balls

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