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Robotic-assisted Trans-peritoneal Pelvic Lymphadenectomy For Metastatic Melanoma: Early Outcomes Compared To Open Pelvic Lymphadenectomy

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Abstract

Background—In the absence of iliac or obturator nodal involvement, the role of pelvic lymphadenectomy (PLND) for melanoma is controversial, but for select patients long-term survival may be achieved with the combination of superficial inguinal (inguinofemoral) and pelvic lymphadenectomy. Open PLND (oPLND) is often limited in visual exposure and may be associated with significant postoperative pain. Robotic PLND (rPLND) is a minimally invasive technique that provides excellent visualization of the iliac and obturator nodes. Outcomes comparing the open and robotic techniques for have not been previously reported for patients with melanoma.

Study Design—We reviewed our experience with rPLND for melanoma and compared clinical and pathologic results to oPLND. We evaluated operative times, nodal yield and short-term oncologic outcomes.

Results—13 rPLND (2013–2015) (15 attempted, 87% success rate) and 25 oPLND (2010–2015) consecutive cases were completed. PLND was combined with an open inguinofemoral dissection in 8 of 13 (62%) robotic and 17 of 25 (68%) open cases. Median length of stay (LOS) was shorter in the rPLND group with 1.0 versus 3.5 days for pelvic only cases ($p < 0.001$) and 2.5 versus 4.0 days ($p < 0.001$) for combined ilioinguinal cases. Median operative time (227 versus 230 minutes, $p = 0.96$) and nodal yield (11 versus 10 nodes, $p = 0.53$) were not different between rPLND and oPLND.

Conclusions—rPLND offers a safe, effective minimally invasive approach to resect the pelvic lymph nodes in patients with melanoma, with no significant difference in nodal yield or operative times, but a shorter LOS compared to oPLND.

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INTRODUCTION

In the absence of biopsy-proven iliac or obturator nodal involvement, the role of pelvic lymphadenectomy (PLND) for patients with melanoma is controversial [1–4]. Relative indications include radiographic suspicion of pelvic disease, involvement of three or more inguinal nodes, large (>3 cm) positive inguinal nodes especially with extracapsular extension of disease, or a pelvic sentinel node (SLN) identified on lymphoscintigraphy that was not sampled in the setting of positive inguinal SLNs (Figure 1)[5]. In select patients with known or suspected pelvic node involvement from melanoma, long-term survival may be achieved with the combination of inguinal and pelvic node dissections [2, 6, 7]. In addition, the relative indications for operative management of pelvic disease may expand as our understanding of long-term outcomes with immune and targeted therapy continues to evolve [8].

The open approach to PLND (oPLND) is generally accomplished via a muscle-splitting lower abdominal incision and extra-peritoneal dissection. This can be associated with limited visualization - especially for the obturator nodes - and is often associated with significant postoperative pain. oPLND typically requires 4–6 weeks of convalescence and may be complicated by wound infection, ileus or incisional hernia [9]. Postoperative pain may also limit early ambulation and contribute to increased risks of deep venous thrombosis, though the complications of oPLND are poorly characterized. Anecdotally, patients and providers may avoid or defer oPLND due to concerns with pain and prolonged recovery following open surgery [10].

The robotic-assisted trans-peritoneal approach to PLND (rPLND) is a well-described procedure utilized for staging and treatment of urologic and gynecologic malignancies [11, 12]. For these indications, laparoscopic and robotic assistance allows for excellent exposure and visualization of the pelvis while minimizing postoperative pain, complications and convalescence time [13]. rPLND is accomplished via a trans-peritoneal approach utilizing five ports, and provides improved visualization of both the iliac and obturator nodes compared to oPLND [14].

The published experience with rPLND for melanoma is limited. Sohn *et al* in 2010 reported results involving two patients with no postoperative complications [15]. Pellergrino *et al* in 2013 reported results from four cases with no complications at 1-year follow-up, and a mean postoperative length of stay of 3.8 days [16]. No previously published series has compared pertinent surgical and quality metrics involving the open approach. In this report, we summarize our experience with rPLND for melanoma at a high volume center and compare these outcomes to a cohort of patients treated with oPLND.

METHODS

We performed a retrospective review of all consecutive cases with the diagnosis of malignant melanoma and a procedure code for pelvic lymph node dissection. For oPLND we included cases from January 2010 through October 2015, and for rPLND we included cases from the beginning of our experience in 2013. An overlapping cohort (historical plus concurrent

cases) was used with the goal of increasing sample size and statistical power. The historical cases included before the introduction of rPLND also help to reduce the impact of selection bias, which may be present in the concurrent cases.

Cases were included if they involved PLND alone or combined with a superficial inguinal node dissection. Hospital records including patient demographics, oncologic history (tumor location, Breslow depth and sentinel lymph node biopsy (SLNB) results), operative notes, intraoperative nursing and anesthesia documentation, pathology reports, hospital records including length of stay (LOS), and clinical and oncologic outcomes were reviewed for each patient. Indication for surgery was determined from the preoperative clinic notes and/or operative reports. Operating room (OR) time was calculated as the difference between “in room” and “out of room” time, while surgery time was calculated as the difference between “incision” and “close” time. Estimated blood loss (EBL) was obtained from the anesthetic record.

Preoperative evaluation and indications for surgery

Decisions to proceed with PLND and the operative approach were made by the treating surgeon after discussion at a multi-disciplinary cutaneous tumor conference. Obese patients were more likely to be considered for rPLND, while patients with extensive prior abdominal or pelvic surgery were more likely to be consigned to oPLND. Preoperative staging was performed using computed tomography (CT) or whole body positron emission tomography/CT (PET/CT) and brain magnetic resonance imaging (MRI). All rPLND were performed by one of two surgical oncologists (AAS and JSZ). oPLND was performed alone or in combination with a superficial inguinal lymph node dissection by one of 3 surgical oncologists (AAS, JSZ, VKS). Patients were administered preoperative antibiotics and antithrombotic prophylaxis with sequential compression devices and postoperative low molecular weight heparin. All superficial inguinal dissections were performed via an open technique; when in the same operative setting these were performed before oPLND or after completion of the rPLND.

Technical details of robotic PLND

After the induction of general endotracheal anesthesia and placement of a Foley catheter, the patient was placed in low-lithotomy position. The Da Vinci robot (Intuitive Surgical, CA, USA) was docked in standard fashion, with the column positioned between the patient’s legs. Access to the peritoneal cavity was obtained in the supraumbilical position via the Hassan technique. A 12 mm midline port was placed under direct visualization approximately 18–20 cm above the pubic symphysis. Two 8 mm robotic ports were placed laterally on the contralateral side of the abdomen from the site of pelvic dissection, at least 14 cm from the pubic symphysis, and at least 6 cm away from other ports. A 12 mm assistant port was placed in the mid-clavicular line on the affected side of the abdomen. A third 8 mm robotic port was placed on the affected side of the abdomen at least 8 cm lateral to the assistant port and at least 2 cm medial to the anterior superior iliac spine (Figure 2).

The patient was placed in steep Trendelenberg and the small and large bowel was reflected away from the pelvis, and adhesiolysis was performed if necessary. In the retroperitoneum,

the psoas muscle, ureter and common iliac bifurcation were identified. The lymph node packet overlying and between the external iliac artery and vein was dissected from underneath the inguinal ligament to the iliac bifurcation or higher if indicated (Figure 3). After removal of the iliac nodal packet, resection of the obturator lymph nodes was performed. The iliac vein was retracted laterally, and the obturator nodes were carefully dissected free of their attachments, identifying and preserving the obturator vessels and nerve. Each lymph node packet was placed in an endoscopic retrieval bag and removed through the midline port. For cases where rPLND was combined with a superficial inguinal lymphadenectomy, the rPLND preceded the inguinal lymphadenectomy to avoid leakage of CO₂ into the operative field.

Technical details of open PLND

For an oPLND, the retroperitoneal space was entered by dividing the external oblique fascia and dividing or splitting the internal oblique muscle—leaving the inguinal ligament intact. The external iliac vessels were exposed by blunt dissection and retraction of the peritoneum. Dissection of the iliac lymph nodes was routinely performed from the inguinal ligament to the iliac bifurcation. Next, the external iliac vessels were retracted laterally or medially, and the obturator lymph nodes were freed from the obturator nerve and vessels and excised. Lymph node specimens were removed in separate external iliac and obturator packets, or piecemeal if necessary.

Postoperative management and surveillance

Postoperative management was administered at the discretion of the treating surgeon, but typically included oral pain medications on the day of surgery for rPLND and intravenous patient-controlled anesthesia (PCA) for the oPLND group. All patients were offered clear liquids on postoperative day one, with the diet being advanced as tolerated. Patients with a combined procedure were managed with a Foley catheter and bedrest until postoperative day one, and evaluated and treated by a physical therapist for education regarding range of motion exercises and lymphedema precautions. Criteria for hospital discharge included adequate pain control on oral pain medication, ability to void without the catheter and adequate independent ambulation and mobility. Patients were followed according to stage-specific institutional follow-up guidelines every 3–4 months for 2 years and every 6 months thereafter. Follow-up included clinical exams and whole body PET-CT scan, with brain MRI if indicated.

Statistical analysis

Normally distributed continuous variables were summarized by mean and standard deviation and compared using the Student t-test. Non-normally distributed continuous variables were summarized by median and range and compared using the Wilcoxon rank sum test. All tests were two-sided and a p value ≤ 0.05 was considered significant. Data were analyzed using Stata 14.0 (StataCorp LP, College Station, TX). The study was approved by the Institutional Review Board of the University of South Florida.

RESULTS

Clinicopathologic parameters

During the study period, 13 rPLND (15 attempted, 87% success rate) and 25 oPLND were performed. One rPLND was aborted due to technical difficulty in achieving pneumoperitoneum in a morbidly obese patient. The patient had previously declined oPLND for an indication of pelvic drainage on SLNB with positive inguinal disease due to occupational concerns and an inability to take prolonged convalescence leave, therefore an oPLND was not performed. One case was converted from rPLND to oPLND in a patient with extensive prior pelvic surgery. The patient had undergone previous PLND at an outside institution and had a hypermetabolic lesion in the pelvis on PET. Even after conversion and despite extensive lysis of adhesions and skeletonization of the iliac vessels, the hypermetabolic lesion could not be identified and no nodes were removed. For the analysis comparing intraoperative and clinical outcomes, these aborted lymphadenectomies were excluded. There was no difference in age, gender or location of the cutaneous primary melanoma between the groups (Table 1). PLND was combined with an open superficial inguinal dissection in 8 of 13 (62%) rPLND and 17 of 25 (68%) oPLND. Many of the primary melanomas were relatively thick, with a mean Breslow depth of 4.0mm for the rPLND group (range 0.8–19 mm) and 3.8 mm (range 0.5–9.2 mm) for the oPLND group ($p=0.92$).

Indications for PLND are also summarized in Table 1. In the rPLND group, the indications were for large ($>3\text{cm}$) inguinal nodes ($n=3$, 23%), radiographic evidence of pelvic nodal disease ($n=6$, 47%) and unsampled pelvic drainage on initial lymphoscintigraphy with final pathology demonstrating a positive inguinal SLNB ($n=4$, 31%). For the oPLND group, no patients had oPLND for unsampled pelvic drainage on lymphoscintigraphy in the setting of a positive inguinal SLNB. Fourteen oPLND patients (56%) had large ($>3\text{cm}$) inguinal disease and 11 patients (44%) had radiographic evidence of disease in the pelvis likely accounting for the hypermetabolic activity seen on PET.

Operative parameters

Operative parameters, including median OR time (284 minutes for rPLND and 265 minutes for oPLND cases, $p=0.48$) and median surgery time (227 minutes for rPLND and 230 minutes for oPLND, $p=0.96$), were not statistically significant between groups (Table 2). In single-basin cases, the median OR time (193 minutes for oPLND and 228 for rPLND, $p=0.02$) and median surgery time (126 minutes for oPLND and 172 for rPLND, $p=0.44$) were shorter for the oPLND. There was no difference in median OR time (283 minutes for oPLND and 284 minutes for rPLND, $p=0.44$) or median surgery time (243 minutes for oPLND and 241 minutes rPLND, $p=0.79$) for combined cases. EBL was minimal for both groups, but slightly lower for rPLND (median of 50mL for rPLND versus 100mL for oPLND, $p=0.03$). One patient in the oPLND group (1/25, 4%) received a blood transfusion in the postoperative period for symptomatic anemia (hemoglobin of 7.9 mg/dL on postoperative day 7 compared to a preoperative value of 11.3 mg/dL with a reported intraoperative EBL of 50mL).

The median pelvic nodal yield was 11 nodes (range 5–16) for the rPLND and 10 nodes (range 5–16) for the oPLND groups ($p=0.53$). The median number of positive nodes was 0 (range 0–5, mean 0.62 nodes) for the rPLND and 1 (range 0–8, mean 1.8 nodes) for the oPLND groups ($p=0.02$). One patient in the rPLND with an indication of radiographic suspicion of disease had been previously treated with a BRAF inhibitor and had one node that was extensively necrotic, but negative for malignancy. Another patient in the rPLND group had a history of metastatic melanoma and a PET positive pelvic mass. All nodes were negative, but at the time of surgery the ipsilateral ovary was noted to contain a hemorrhagic corpus luteum.

Clinical outcomes

Median hospital length of stay was shorter for the rPLND group (median 2 days, range 1–3 days) as compared to the oPLND group (median 4 days, range 1–7 days, $p<0.001$) (Table 3). The median LOS remained shorter in the rPLND group when stratifying for pelvic alone versus combined cases. For pelvic only (single basin) cases, the median LOS was 1 day for rPLND versus 3.5 days for oPLND ($p=0.001$). For combined cases, the median LOS was 2.5 days for rPLND versus 4 days for oPLND ($p<0.001$). The overall frequency of any postoperative complication was not different between the two groups ($p=0.29$) (Table 3). Postoperative lymphedema (as documented in the clinical charts based on physical exam) was not different between groups (36% vs. 23%, $p=0.48$). In our institution the reduction in LOS by a median of 2 days would result in a cost savings of \$5,625 per patient, even after accounting for the higher OR costs associated with rPLND (Table 4). Formal cost analysis on patient level data was outside the scope of this study.

Oncologic outcomes

The oPLND cohort had a median follow-up of 23 months, compared to a median follow-up of 8 months for the rPLND cohort. Oncologic outcomes and in-basin recurrence to date do not differ between groups ($p=0.76$) (Table 3). There was one in-basin recurrence in the oPLND group that was unresectable; the patient subsequently achieved a complete clinical response to a BRAF-inhibitor and has no evidence of disease at the time of data reporting.

DISCUSSION

The role of pelvic lymph node dissection (PLND) for melanoma is controversial, but some groups have reported long-term survival in select patients with melanoma undergoing combined inguinal and pelvic dissection [4, 6, 7]. With the anticipated results of the Multicenter Selective Lymphadenectomy Trial II (MSLT-II) trial and improved systemic therapies the specific indications for PLND may be further altered [8], and the role of PLND in the setting of micrometastatic inguinal disease with pelvic drainage on lymphoscintigraphy remains unclear [17]. Even in the setting of the rapidly changing landscape of melanoma treatment, there will continue to be a subset of patients for whom PLND is indicated. Robotic-assisted PLND (rPLND) offers the potential to minimize morbidity and convalescence time in these patients.

Achieving equivalent lymph node yield and an equivalent or superior in-basin failure rate is a critical prerequisite for adoption of rPLND. In our series, we report an equivalent lymph node yield to oPLND with a median of 11 lymph nodes retrieved (compared to a median of 10 nodes in the oPLND group, $p=0.53$). Patients having a combined ilioinguinal dissection had a median of 20 nodes removed (range 11–33) and this value exceeds the minimum numbers used as quality indicators for regional combined lymphadenectomy [18]. In a previous report of rPLND by Ross *et al*, lymph node yield ranged from 5 to 8 lymph nodes in 3 patients [10]. We detected one in-basin recurrence after oPLND after a median follow-up of 23 months, compared to no in-basin recurrences in the rPLND group with a median follow-up of 8 months. Given the differences in follow-up for the cohorts, long-term oncologic outcomes should be interpreted with caution and continued follow-up will be necessary.

In addition to achieving equivalent lymph node yield, we have also demonstrated that rPLND can be used by cutaneous surgical oncologists without a significant increase in operative time. Utilization of a dedicated operating room team experienced in robotic set-up, as is the practice in our institution, is critical in maintaining equivalent OR room and turnover times [19]. Partnering with surgeons experienced with rPLND for other indications can also help minimize the learning curve. Prior to offering rPLND for patients with melanoma, our cutaneous surgical oncologists observed and assisted on rPLND for urologic indications. Additionally, an experienced urologist (JMP-S) proctored early cases in our series until the surgical oncologists achieved proficiency with the technique. We advocate a model in which the cutaneous surgical oncologist performs the rPLND (rather than turning over this portion of the case to a urologist or gynecologist), given the expertise in tumor biology and the ability to perform combined superficial inguinal lymphadenectomy without the need for coordination of two surgical teams. Achieving comparable operative parameters, especially early in the series, is particularly dependent on patient selection. We aborted one rPLND in an obese patient, and one rPLND was converted to open due to extensive adhesiolysis, but resection was not achieved. A history of extensive abdominal or pelvic surgery may represent a relative contraindication to the robotic approach, especially in the early experience of the surgeon.

While this is a relatively small series of patients, we were able to demonstrate a reduction in hospital LOS associated with the rPLND. In combined cases of rPLND and open superficial inguinal dissection, LOS was equivalent to what we typically observe for open superficial inguinal dissection alone. For patients who underwent isolated rPLND, median LOS was 1 day, with a convalescent period of two weeks or less. In our series, the reduction in LOS by a median of 2 days resulted in a cost savings of an average of \$5,625 per patient, after accounting for the higher OR costs associated with the robotic approach (Table 4). While we do not include the cost of robot acquisition in this analysis, we would not advocate or assume any hospital would acquire a robotic system for this relatively rare indication, and therefore assume the acquisition cost are already incurred by the institution. For patients who will be treated with adjuvant systemic or radiation therapy, a short convalescence period allows for more rapid initiation of therapy. It is possible that similar results can be achieved with a strictly laparoscopic approach without the costs associated with robotic technology. The robotic approach, however, has the advantage of three-dimensional visualization,

ergonomic, intuitive control and wristed instruments that approximate the motion of the human hand, which are all advantageous given the extensive dissection in close proximity to iliac vessels and the obturator nerve.

The strength of this study is that it is the first to document important surgical and oncologic outcomes of rPLND for metastatic melanoma as compared to the oPLND approach, all performed by experienced melanoma surgical oncologists. Despite this, there are several important limitations. First, the groups were selected rather than randomized, and there may be unaccounted-for covariates responsible for the reduced LOS. The non-randomized selection of the operative approach also limits generalizability of operative and surgery time data. It is probable that the most technically challenging cases were selected for oPLND approach initially, thereby limiting comparison of these operative times. This selection bias is likely necessary in the early adoption of this new approach, with the opportunity to expand the technique to more challenging cases as the operative team becomes more proficient. Finally, given that this series is limited to a single institution with a high volume of both cutaneous and robotic surgery, it is uncertain whether these results can be generalized to centers with lower volumes of advanced melanoma and/or robotic surgery. Future reports should include multi-institutional experiences, preferably in a randomized controlled clinical trial to further define outcomes and role of rPLND for metastatic melanoma and include other important patient centered outcomes such as patient satisfaction, return to work and quality of life.

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ABBREVIATIONS

PLND	pelvic lymphadenectomy
rPLND	robotic-assisted pelvic lymphadenectomy
oPLND	open pelvic lymphadenectomy
BMI	body mass index
LOS	length of stay
SLN	sentinel lymph node
SLNB	sentinel lymph node biopsy
OR	operating room
PET/CT	positron emission tomography/computed tomography
MRI	magnetic resonance imaging

REFERENCES

1. Egger ME, Brown RE, Roach BA, Quillo AR, Martin RC 2nd, Scoggins CR, Stromberg AJ, McMasters KM. Addition of an iliac/obturator lymph node dissection does not improve nodal recurrence or survival in melanoma. *J Am Coll Surg*. 2014; 219(1):101–108. [PubMed: 24726566]

2. Strobbe LJ, Jonk A, Hart AA, Nieweg OE, Kroon BB. Positive iliac and obturator nodes in melanoma: survival and prognostic factors. *Ann Surg Oncol*. 1999; 6(3):255–262. [PubMed: 10340884]
3. Kretschmer L, Neumann C, Preusser KP, Marsch WC. Superficial inguinal and radical ilioinguinal lymph node dissection in patients with palpable melanoma metastases to the groin--an analysis of survival and local recurrence. *Acta Oncol*. 2001; 40(1):72–78. [PubMed: 11321665]
4. Coit DG, Brennan MF. Extent of lymph node dissection in melanoma of the trunk or lower extremity. *Arch Surg*. 1989; 124(2):162–166. [PubMed: 2464981]
5. Clinical Practice Guidelines in Oncology--Melanoma. [http://www.nccn.org/professionals/physician_gls/pdf/melanoma.pdf].
6. Hughes TM, Thomas JM. Combined inguinal and pelvic lymph node dissection for stage III melanoma. *Br J Surg*. 1999; 86(12):1493–1498. [PubMed: 10594495]
7. Glover AR, Allan CP, Wilkinson MJ, Strauss DC, Thomas JM, Hayes AJ. Outcomes of routine ilioinguinal lymph node dissection for palpable inguinal melanoma nodal metastasis. *Br J Surg*. 2014; 101(7):811–819. [PubMed: 24752717]
8. Gibney GT, Atkins MB. Swinging for the Fences: Long-Term Survival With Ipilimumab in Metastatic Melanoma. *J Clin Oncol*. 2015; 33(17):1873–1877. [PubMed: 25964248]
9. van der Ploeg AP, van Akkooi AC, Schmitz PI, van Geel AN, de Wilt JH, Eggermont AM, Verhoef C. Therapeutic surgical management of palpable melanoma groin metastases: superficial or combined superficial and deep groin lymph node dissection. *Ann Surg Oncol*. 2011; 18(12):3300–3308. [PubMed: 21537867]
10. Ross AD, Kumar P, Challacombe BJ, Dasgupta P, Geh JL. The addition of the surgical robot to skin cancer management. *Ann R Coll Surg Engl*. 2013; 95(1):70–72. [PubMed: 23317733]
11. Ploussard G, Briganti A, de la Taille A, Haese A, Heidenreich A, Menon M, Sulser T, Tewari AK, Eastham JA. Pelvic lymph node dissection during robot-assisted radical prostatectomy: efficacy, limitations, and complications-a systematic review of the literature. *Eur Urol*. 2014; 65(1):7–16. [PubMed: 23582879]
12. Seamon LG, Fowler JM, Richardson DL, Carlson MJ, Valmadre S, Phillips GS, Cohn DE. A detailed analysis of the learning curve: robotic hysterectomy and pelvic-aortic lymphadenectomy for endometrial cancer. *Gynecol Oncol*. 2009; 114(2):162–167. [PubMed: 19428096]
13. Benito V, Romeu S, Esparza M, Carballo S, Arencibia O, Medina N, Lubrano A. Safety and Feasibility Analysis of Laparoscopic Lymphadenectomy in Pelvic Gynecologic Malignancies: A Prospective Study. *Int J Gynecol Cancer*. 2015
14. Png KS, Koch MO. Technique of pelvic lymphadenectomy after robot-assisted laparoscopic prostatectomy for prostate cancer. *J Endourol*. 2012; 26(12):1600–1604. [PubMed: 23075403]
15. Sohn W, Finley DS, Jakowatz J, Ornstein DK. Robot-assisted laparoscopic transperitoneal pelvic lymphadenectomy and metastasectomy for melanoma: initial report of two cases. *J Robot Surg*. 2010; 4(2):129–132. [PubMed: 20730107]
16. Pellegrino A, Damiani GR, Terruzzi M, Strippoli D, Bigi L. Robot-assisted laparoscopic transperitoneal deep pelvic lymphadenectomy for metastatic melanoma of the lower limb: initial report of four cases and outcomes at 1-year follow-up. *Updates Surg*. 2013; 65(4):339–340. [PubMed: 23519895]
17. Mozzillo N, Pasquali S, Santinami M, Testori A, Di Marzo M, Crispo A, Patuzzo R, Verrecchia F, Botti G, Montella M, et al. Factors predictive of pelvic lymph node involvement and outcomes in melanoma patients with metastatic sentinel lymph node of the groin: A multicentre study. *Eur J Surg Oncol*. 2015; 41(7):823–829. [PubMed: 25800935]
18. Spillane AJ, Haydu L, McMillan W, Stretch JR, Thompson JF. Quality assurance parameters and predictors of outcome for ilioinguinal and inguinal dissection in a contemporary melanoma patient population. *Ann Surg Oncol*. 2011; 18(9):2521–2528. [PubMed: 21556951]
19. Lasser MS, Patel CK, Elsamra SE, Renzulli JF 2nd, Haleblan GE, Pareek G. Dedicated robotics team reduces pre-surgical preparation time. *Indian J Urol*. 2012; 28(3):263–266. [PubMed: 23204651]
20. Schraml P, von Teichman A, Mihic-Probst D, Simcock M, Ochsenbein A, Dummer R, Michielin O, Seifert B, Schlappi M, Moch H, et al. Predictive value of the MGMT promoter methylation status

in metastatic melanoma patients receiving first-line temozolomide plus bevacizumab in the trial SAKK 50/07. *Oncology reports*. 2012; 28(2):654–658. [PubMed: 22614944]

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Figure 1.

Example of pelvic drainage on lymphoscintigraphy at the time of sentinel lymph node (SLN) biopsy. Two-dimensional planar lymphoscintigraphy (top panels) shows a markedly radioactive node or nodes in the groin, with a higher node identified (upper right panel) suggesting pelvic drainage. A transverse three-dimensional fused single positron emission computed tomography/CT (SPECT/CT) image confirms this represents an external iliac lymph node. This patient (not included in the current series) had one inguinal SLN with multifocal micrometastatic melanoma, 0.50 mm in greatest dimension, without sampling of

the pelvic node – a potential indication at our institution for pelvic lymph node dissection at the time of superficial inguinal node dissection.

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Figure 2.
 Port placement for a left robotic assisted trans-peritoneal pelvic lymphadenectomy demonstrating three 8mm robotic ports, a 12mm port for the camera (center) and a 12mm assistant port (left abdomen).

Figure 3.
Intraoperative photograph depicting the anatomy following robotic assisted left pelvic lymph node dissection (rPLND). **A** denotes the left external iliac artery, **V** denotes the left external iliac vein, and **N** denotes the left obturator nerve.

Table 1

Clinical features and operative indications for robotic versus open pelvic lymphadenectomy for metastatic melanoma.

	rPLND (n=13)	oPLND (n=25)	p-value
Demographics			
Female n (%)	11 (85)	16 (64)	0.18
Age (years, mean)	56 ± 17	61 ± 14	0.34
Location of Tumor			
Leg Below Knee n (%)	6 (47)	16 (64)	0.74
Leg Above Knee n (%)	3 (23)	7 (28)	
Buttock or Flank n (%)	3 (23)	2 (8)	
Unknown n (%)	1 (8)	0 (0)	
Breslow Depth of Primary Tumor			
Mean (mm)	4.0 (0.8–19)	3.8 (0.5–9.2)	0.92
Indications for Pelvic Node Dissection			
Inguinal nodes >3cm groin disease n (%)	3 (23)	14 (56)	0.01 *
Radiographic Evidence of Pelvic Disease n (%)	6 (47)	11 (44)	
Pelvic Drainage on SLNB (not sampled) in setting of positive inguinal SLN n (%)	4 (31)	0 (0)	

rPLND (robotic pelvic lymph node dissection); oPLND (open pelvic lymph node dissection); SLNB (sentinel lymph node biopsy);

* tested by one-way ANOVA

Table 2

Operative times and outcomes for robotic versus open pelvic lymphadenectomy for metastatic melanoma.

	rPLND (n=13)	oPLND (n=25)	p-Value
Combined or Staged Procedure (open superficial inguinal + o/r PLND)*			
Combined case n (%)	(8) 62	(17) 68	0.93
Operative Parameters			
Total OR Room Time (minutes)	284	265	0.48
Total OR Surgeon Time (minutes)	227	230	0.96
Estimated Blood Loss [20]	50	100	0.03
Lymph Node Yield			
Number Retrieved (median)	11 (5–16)	10 (5–16)	0.53
Number Positive (median)	0 (0–5)	1 (0–8)	0.03

rPLND (robotic pelvic lymph node dissection); oPLND (open pelvic lymph node dissection); OR (operating room)

Table 3

Clinical outcomes for robotic versus open pelvic lymphadenectomy for metastatic melanoma.

	rPLND (n=13)	oPLND (n=25)	p-Value
Hospital Length of Stay			
Days (median)	2 (1–3)	4 (1–7)	<0.001
Pattern of Recurrence			
In Basin	0	1	0.76*
Local or In-Transit	1	5	
Distant Disease	3	11	
No evidence of disease	9	8	
Complications			
None	9 (69)	12 (48)	0.29*
Wound Infection	1 (8)	1 (4)	
Lymphedema	3 (23)	9 (36)	
Chronic Pain	0 (0)	1 (4)	
Ileus	0 (0)	1 (4)	
Incisional hernia	0 (0)	1 (4)	

rPLND (robotic pelvic lymph node dissection); oPLND (open pelvic lymph node dissection);

* compared using one-way ANOVA

Table 4

Average cost by approach for pelvic lymph node dissection for metastatic melanoma.

	Robotic PLND	Open PLND
Average * OR Cost (Anesthesia, Preop, OR and PACU)	\$6,153	\$5,763
Average * Non-OR Cost	\$3,714	\$9,729
Average * Total Cost	\$9,867	\$15,492

* Mean costs of all cases performed at Moffitt Cancer Center for fiscal year 2014.