Robot Assisted Cystectomy With Holmium Laser Debridement for Osteomyelitis of the Pubic Symphysis With Urinary Fistula

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OBJECTIVE To assess the success of robot-assisted holmium laser debridement of the pubic symphysis for osteomyelitis of the pubic symphysis with associated urosymphyseal fistula. Traditionally, excision of the fistulous tract and concomitant cystectomy with urinary diversion and pubic symphyseal debridement has been done using an open approach. This paper presents patients who were successfully managed with this approach.

METHODS AND MATERIALS Between January 2007 and January 2018, all patients who underwent pubic symphyseal debridement with or without cystectomy were identified. We reviewed patients who underwent planned robot-assisted cystectomy with holmium laser debridement for osteomyelitis of the pubic symphysis as a result of urinary fistula. Data on clinical presentation, perioperative outcomes, and recurrence of urinary tract fistula and symptoms were collected.

RESULTS Twelve patients underwent holmium laser debridement of the pubic symphysis during robot-assisted cystectomy for urinary fistula. Eleven patients had prior radiation treatments for prostate cancer with all having failed prior conservative management. Median operative time was 270 minutes with median length of stay of 5 days. At last follow-up, 11 (91.7%) of patients had complete resolution of their urinary fistula at median follow-up of 29 months. No patients developed osteonecrosis of the bone or complications from their urinary diversion at last follow-up.

CONCLUSION Definitive surgical treatment with holmium laser debridement of the pubic symphysis with concomitant robot-assisted cystectomy and urinary diversion is a safe and durable approach to the complex problem of urinary fistula with pubic symphysis osteomyelitis. UROLOGY 134: 124–134, 2019. © 2019 Elsevier Inc.

INTRODUCTION

Osteomyelitis of the pubic symphysis with associated urosymphyseal fistula (USF) is a rare complication following the treatment of prostate cancer and is associated with a history of radiation to the region. Additional treatments to the irradiated prostate or prostate fossa such as cryotherapy, laser prostatectomy, and other focal treatments lead to this debilitating complication.[1,2] Patients present with osteomyelitis of the pubic symphysis resulting in pain, sepsis, and significant deterioration in quality of life.[2,3] Pathognomonic signs are point tenderness at the pubic symphysis with pain in the pelvis on ambulation. Conservative management often fails, with 75%-94% of patients requiring surgical intervention.[4] Osteomyelitis of the pubic symphysis is also associated with mortality up to 2%.[5]

Traditionally, excision of the fistulous tract and concomitant cystectomy with urinary diversion and pubic symphyseal debridement has been done using an open approach.[1,2] A recent randomized controlled trial demonstrated that robot-assisted radical cystectomy results in significantly less blood loss and length of stay for patients with bladder cancer.[6] Holmium:yttrium-aluminum-garnett (Ho:YAG) lasers have been employed in arthroscopic surgery for ablation and cutting of bone since the 1990s.[7] We have utilized the Ho:YAG laser during robot-assisted cystectomy and urinary diversion for USF to debride the pubic symphysis enabling a completely minimally invasive approach to this challenging clinical situation. This paper presents patients who were successfully managed with robot-assisted Ho:YAG laser debridement

Funding: *AN received some funding to attend fellowship from the Australasian Urologic Foundation.*

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Submitted: June 27, 2019, accepted (with revisions): August 14, 2019

https://doi.org/10.1016/j.urology.2019.08.049
0090-4295

(RALD) of the pubic symphysis. We hypothesize that this technique will be safe and efficacious in managing patients with this disease state.

MATERIALS AND METHODS

Data Source

This is a retrospective study that reviewed the records of all patients who underwent pubic symphysis debridement with or without cystectomy and urinary diversion between January 2007 and January 2018.

Patient Selection

After institutional review board approval, a query of a prospectively maintained database was performed to identify patients who underwent pubic symphysis debridement with or without cystectomy between January 2007 and January 2018. In robotic cases, diversion approach (intracorporeal vs extracorporeal) was determined electively at the time of surgery, but an extracorporeal approach is preferentially used by the operating surgeon (EPC). It was preferable to perform a cystoprostatectomy in males if the prostate is still in situ, otherwise patients underwent simple cystectomy. USF was defined as direct communication between the urinary tract and pubic symphysis confirmed by clinical presentation and cross-sectional imaging with magnetic resonance imaging. Indications for surgery were based on a combination of clinical symptoms and imaging findings of osteomyelitis.

Procedure Details

In the robotic approach, all patients were treated using a transabdominal robotic approach. Robotic and assistant ports and positioning were placed in a usual configuration for robot-assisted cystectomy to what has been previously described.[8] After completion of the cystectomy, and prior to urinary diversion, debridement of the symphysis pubis was conducted (Fig. 1). The debridement of the pubic symphysis was conducted by removal of necrotic cartilage and bone using the toothed robotic Cobra grasper (Intuitive Surgical Inc., Sunnyvale, CA) followed by ablation of cartilage and bone with the Ho:YAG laser fiber to healthy tissue. A 1000 micron end firing Ho:YAG laser fiber is introduced through a 7F open ended laser stabilizing catheter through an assistant port and manipulated with a robotic grasper. We utilized the 100 W and 120 W Lumenis Pulse (Lumenis Ltd, Yokneam, Isreal) laser generator and used settings of 1.5 J x 25 Hz to conduct laser ablation. All necrotic cartilage and bone was ablated with the Ho:YAG laser fiber until healthy tissue was encountered. In all cases only the infected pathologic cartilage and bone is ablated leaving anterior ligamentous support of the pubic symphysis, maintaining the integrity of the pelvic ring.

During the open approach, once cystectomy is completed, the pubic bone was debrided using curettes and rongeurs until healthy appearing bleeding tissue was encountered. Electrocautery was used to obtain hemostasis. The debridement is typically performed by our orthopedic colleagues.

Variables Measured

Data were collected regarding patient demographics, presentation, primary pathology, previous treatments, perioperative outcomes, and long term resolution. Median values were reported with their interquartile range.

RESULTS

Out of 15 total pubic bone debridement procedures, we identified were 12 patients who were treated with RALD of the pubic symphysis. All RALD patients were male with a median age of 75 (70.75-80.25). Patients had a median American Society of Anesthesiologists score was 3 (2.75-3) and median Charleston comorbidity index of 7.5 (6.75-9).

Eleven patients were treated initially for prostate cancer with 1 patient developing a USF secondary to a photoselective vaporization of the prostate (PVP) for benign prostatic hyperplasia (BPH). Eleven of 12 patients (91.2%) were treated with radiation therapy for prostate cancer with 10 having primary external beam radiotherapy and 1 having low dose rate brachytherapy with 6 (50%) having salvage treatments (see Table 1). All patients had failed conservative measures with antibiotics and less invasive treatments.

All of the patients in this series had a bladder neck contracture and/or urethral stricture with 8 (66.7%) requiring either a bladder neck dilatation or incision prior to RALD of the pubic symphysis.

All patients presented with osteomyelitis of the pubic bone. Ten (83.3%) patients had a proven fistula on preoperative cross-sectional imaging (Fig. 2), whereas the diagnosis of fistula was indeterminate in the remaining 2 on imaging. Ten (83.3%) patients presented as being foley catheter dependent usually due to end-stage bladder symptoms such as retention ($n = 4$) or severe incontinence ($n = 6$).

The median total operative time was 270 minutes (252.5-293.3) with an estimated intraoperative blood loss of 100mL (100-150 mL). Eleven patients had a cystectomy with the remaining patient having only RALD of the pubic symphysis as a complication of PVP for BPH. Ten (83.3%) patients had ileal conduit urinary diversion with the majority being extracorporeal ($n = 8$) compared to intracorporeal ($n = 2$), as 1 patient underwent only RALD (patient 10) and the other had a prior ileal conduit surgery for urinary incontinence (patient 3). One patient required open conversion due to extensive intra-abdominal adhesions. The pubic symphysis was debrided using the Ho:YAG laser in this case. There were no intraoperative complications.

The median length of stay post-operatively was 5 days (5-6.5). Two (16.7%) of patients required a blood transfusion. No patients experienced ureteroileal anastomotic leak, bowel leak, or prolonged ileus.

There were no patients with malignancy on their final pathology. Tissue was sent for culture in all cases and 10 (83.3%) grew organisms. Cultures were polymicrobial with large degrees of antibiotic resistance (Table 2). All patients required prolonged courses of perioperative intravenous antibiotics and or antifungal therapy for at least 4-6 weeks.

The median follow-up time of patients was 29 (15.2-54.5) months. Surveillance consisted of quarterly cross-sectional imaging in the postoperative setting, as well as urine cultures and follow-up visits. Follow-up magnetic resonance imaging was used to document fistula closure and resolution of osteomyelitis. Eleven (91.7%) patients had complete resolution of symptoms from their USF at last follow-up. No patients developed avascular necrosis of the pubic symphysis as a result of their surgery. Two patients (16.7%) required repeat open debridement of their pubic symphysis due to recurrent osteomyelitis at 16 and 13 months post laser debridement respectively. One (8.3%) of these patients developed a pelvic abscess as a result of a colonic fistula developing 13 months after initial resolution of his symptoms

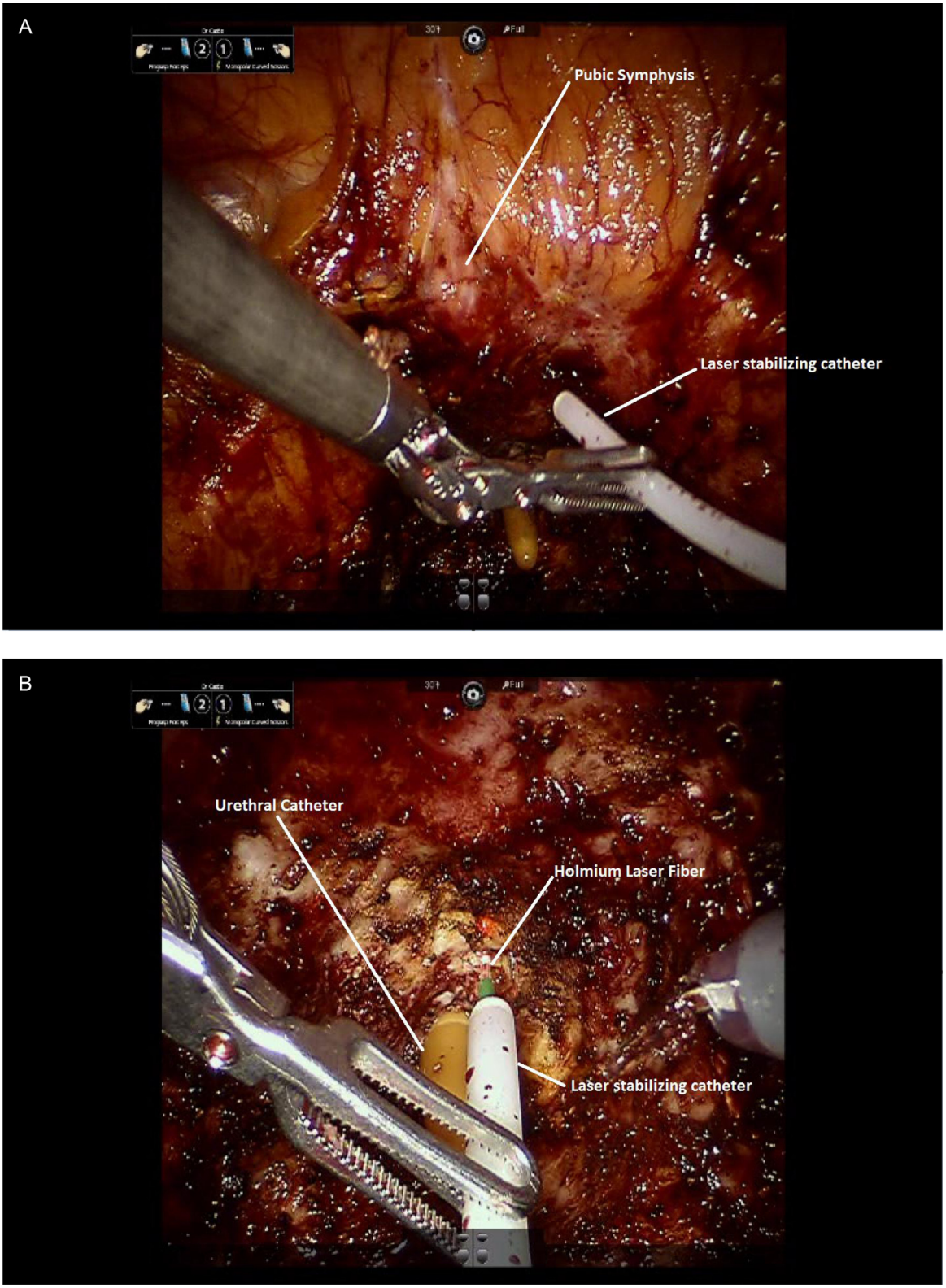


Figure 1. Demonstration of robot-assisted laser debridement of pubic symphysis.

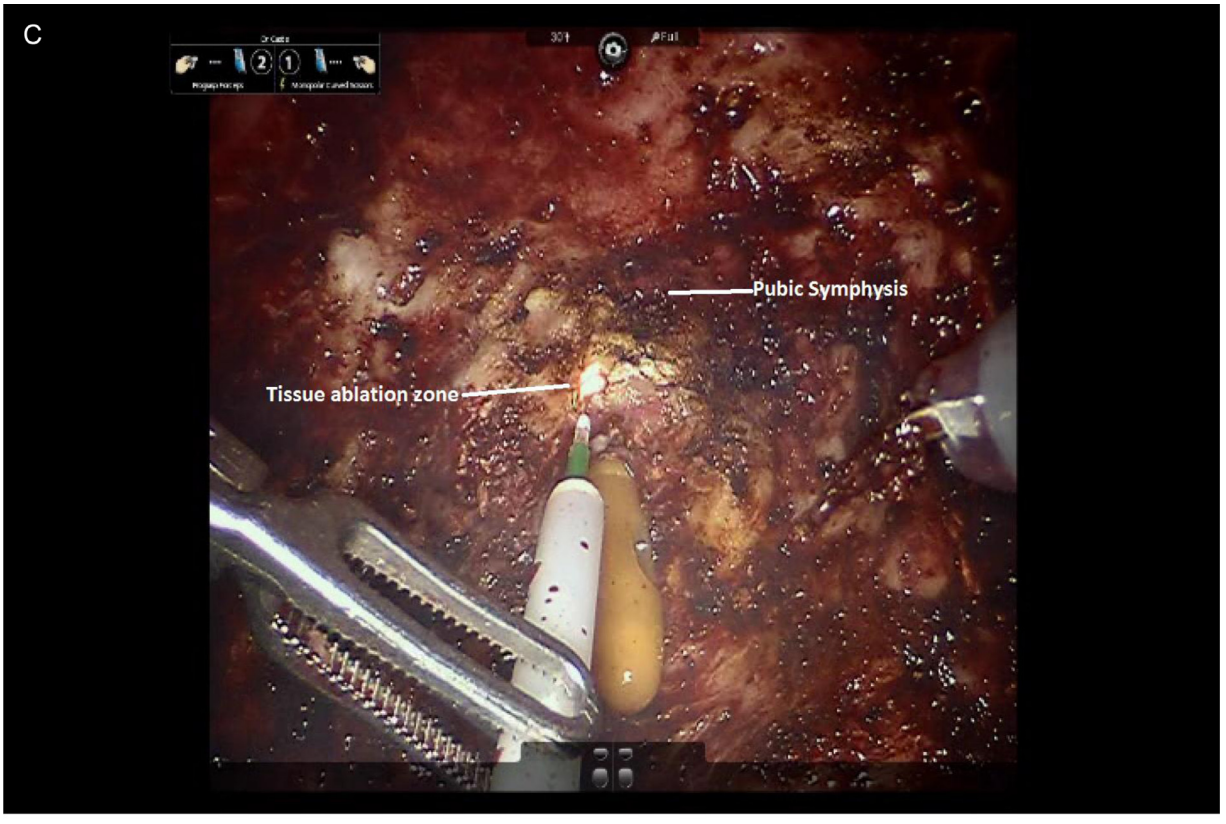
a. Cystectomy has been completed. Introduction of laser stabilizing catheter using the robotic Prograsp (Intuitive Surgical Inc., Sunnyvale, CA) grasper.

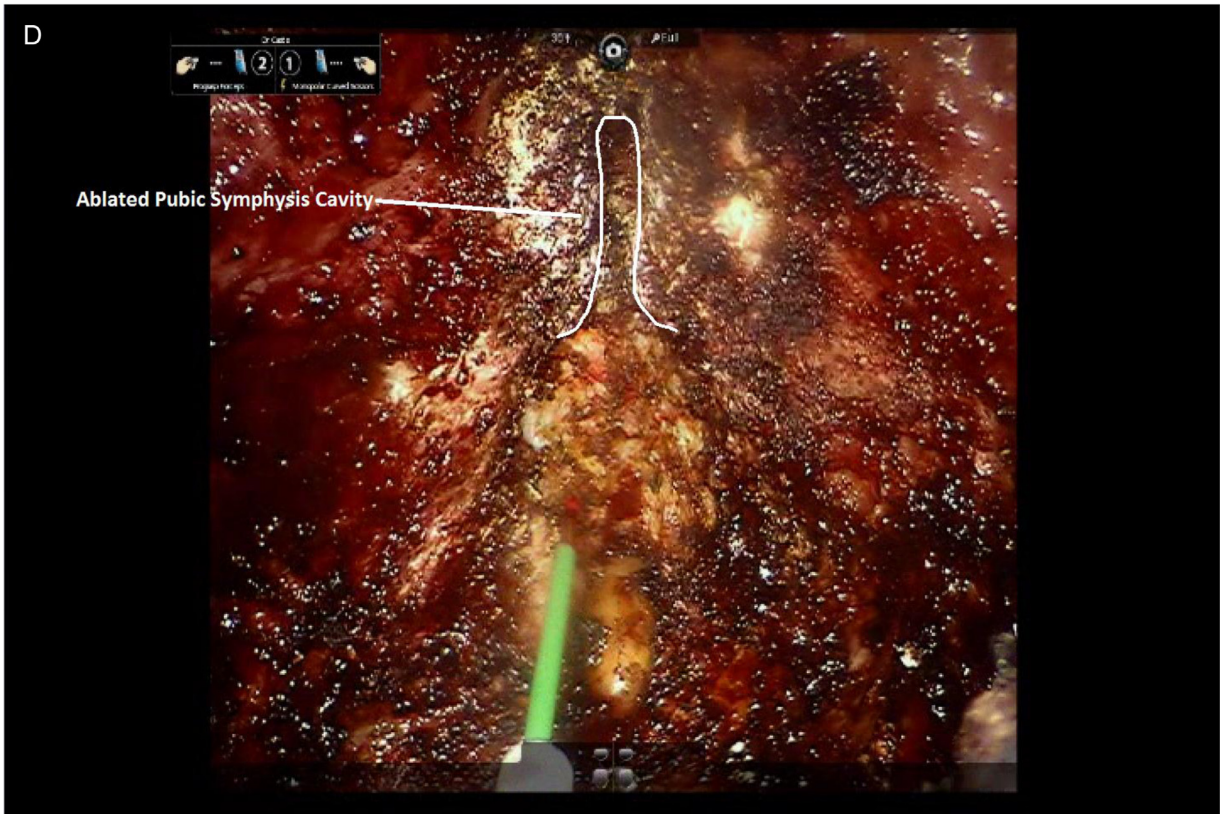
b. Introduction of 1000 micron end firing Holmium laser fiber through laser stabilizing catheter.

c. Live picture of tissue ablation of the fistulous tract and pubic symphysis using a "near-contact" technique.

d. Post ablation image of pubic symphysis cavity completely debrided to healthy tissue. This is marked by the white contoured line.

e. Conceptualized diagram representing intraoperative "action shot" during laser debridement of the pubic symphysis.





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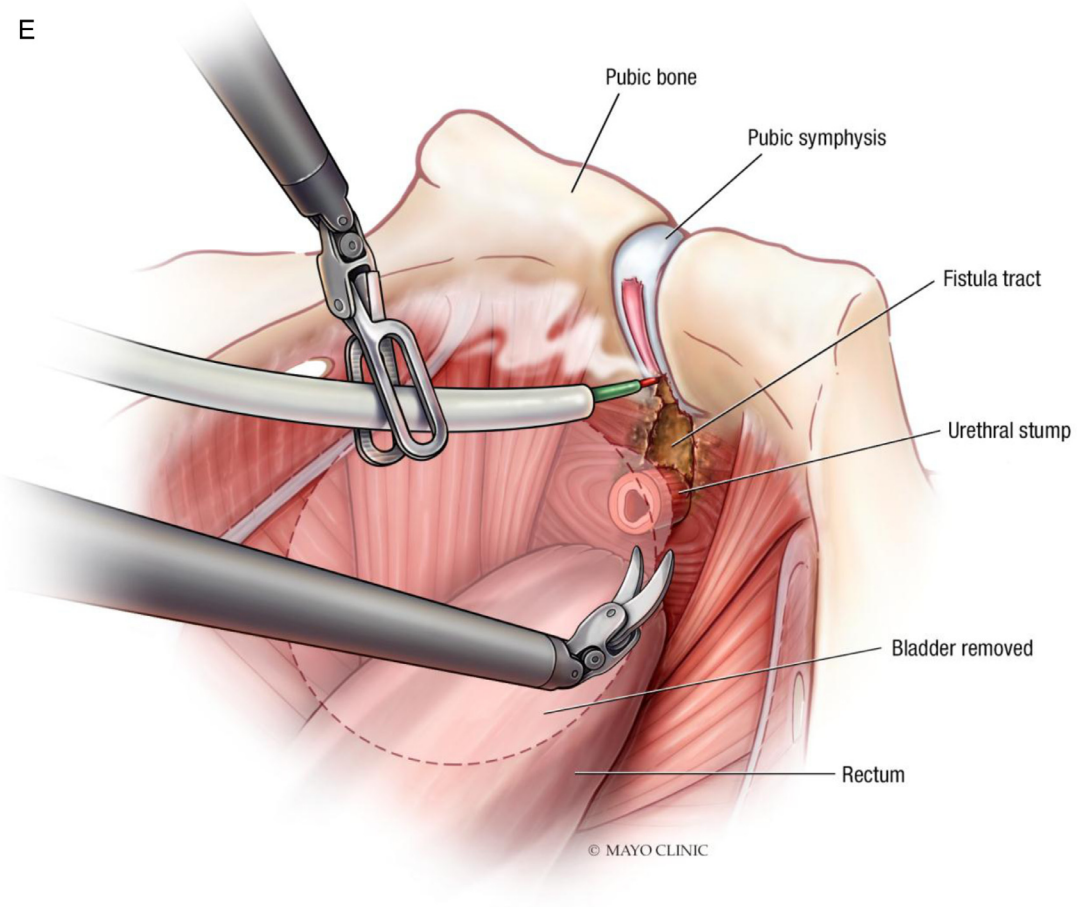

Figure 1. Continued

requiring a subsequent diverting colostomy. It was determined this was secondary to radiation effects on the colon and pelvis and unrelated to the surgery for the USF. On the last follow-up documented for all patients, symptoms related to osteomyelitis (ie, pelvic pain) resolved and patients were otherwise asymptomatic. In the patient who did not have a diversion, urine cultures were negative.

We also queried our database for debridements that were performed via an open approach (Supplement 1 and Supplement 2) and in the 3 patients who were identified, there was 1 female patient. Background information was similar to the RALD cohort (ie, prior history of pelvic radiation therapy) and all patients were incontinent at baseline. One patient had a recurrence that required repeat debridement and drainage of pelvic abscesses.

DISCUSSION

Pubic bone osteomyelitis resulting from USF is a debilitating complication of treatment for prostate pathology usually requiring definitive surgical management with cystectomy and urinary diversion. In almost all cases there is a history of radiation to the pelvis. Patients have often had multimodal treatments and failed attempts at conservative treatment and are elderly with complex medical histories. Utilizing a minimally invasive robotic approach for these patients has the potential to reduce the morbidity associated with recovery following this surgery. This series of patients demonstrates the feasibility and efficacy of a minimally invasive approach management of these patients. Furthermore, the benefits of precise excision/debridement of the infected cartilage and bone allows for maintaining structural integrity of the pelvis.

The use of Ho:YAG laser in arthroscopic surgery has been established previously for treatment of fibrocartilaginous tissue disorders.[9,10] Ablation of cartilaginous tissue is best done by taking advantage of the near-contact laser technique and minimizes damage to normal tissue.[9,11] The main advantage of using the laser as opposed to cautery is the accuracy of dissection and lack of destruction to normal tissue from cautery spray, theoretically allowing for better tissue healing. In-vivo equine laboratory studies have demonstrated minimal thermal tissue injury to adjacent sites and no subchondral sloughing.[12] The Ho:YAG laser also has a shallow depth of penetration of only 0.4 mm, permitting precise debridement. The majority of patients (10/12) in this series did not require repeat debridement reflecting the effectiveness of the Ho:YAG laser to ablate necrotic cartilaginous tissue without medium term complications (Supplement 3). This laser is very familiar to Urologists given its extensive use for stone

Table 1. Patient characteristics

ID	Age	ASA	Prior Pathology	Previous Treatment	Presentation	Bladder Status	Time of Last Follow-up (mo)	Recurrence?
1	71	3	Prostate cancer	RARP with salvage EBRT BND	Pubic Pain, osteomyelitis, Fistulous discharge	Incontinent	68	No
2	55	3	Prostate cancer	EBRT with salvage cryotherapy BND	Osteomyelitis, fistulous discharge	Foley catheter dependent	49	No
3	84	3	Prostate cancer	EBRT with salvage HDR brachy BND	Pubic pain, osteomyelitis	Abandoned (ileal conduit status at time of surgery)	69	No
4	84	3	Prostate cancer	EBRT with salvage HIFU urethral dilatation	Osteomyelitis	Foley catheter dependant	52	No
5	70	2	Prostate cancer	RARP with salvage EBRT urethrotomy	Pain, fistulous discharge, osteomyelitis	Suprapubic tube	60	No
6	75	3	Prostate cancer	Open RRP with salvage EBRT BND	Osteomyelitis, fistulous discharge	Foley catheter dependent	34	Yes
7	73	3	Prostate cancer	EBRT with HDR brachytherapy RARP BND	Osteomyelitis, fistulous discharge	Incontinent	16	No
8	81	2	Prostate cancer	LDR brachytherapy	Osteomyelitis	Incontinent, Urinary Retention	11	No
9	64	3	Prostate cancer	RARP with salvage EBRT BND	Osteomyelitis, fistulous discharge	Urinary Retention – intermittent self catheterization	24	Yes
10	77	3	Benign prostate hyperplasia	PVP BND BNI	Pubic bone pain, osteomyelitis,	Incontinent	4	No
11	75	2	Prostate cancer	EBRT + salvage cryotherapy	Osteomyelitis, fistulous discharge	Incontinent	18	No
12	80	3	Prostate cancer	EBRT and salvage LDR brachytherapy BNI	Pelvic pain, Osteomyelitis, urinary sepsis	Incontinent	6	No

BND, bladder neck dilatation; BNI, bladder neck incision; RARP,robot assisted radical prostatectomy.

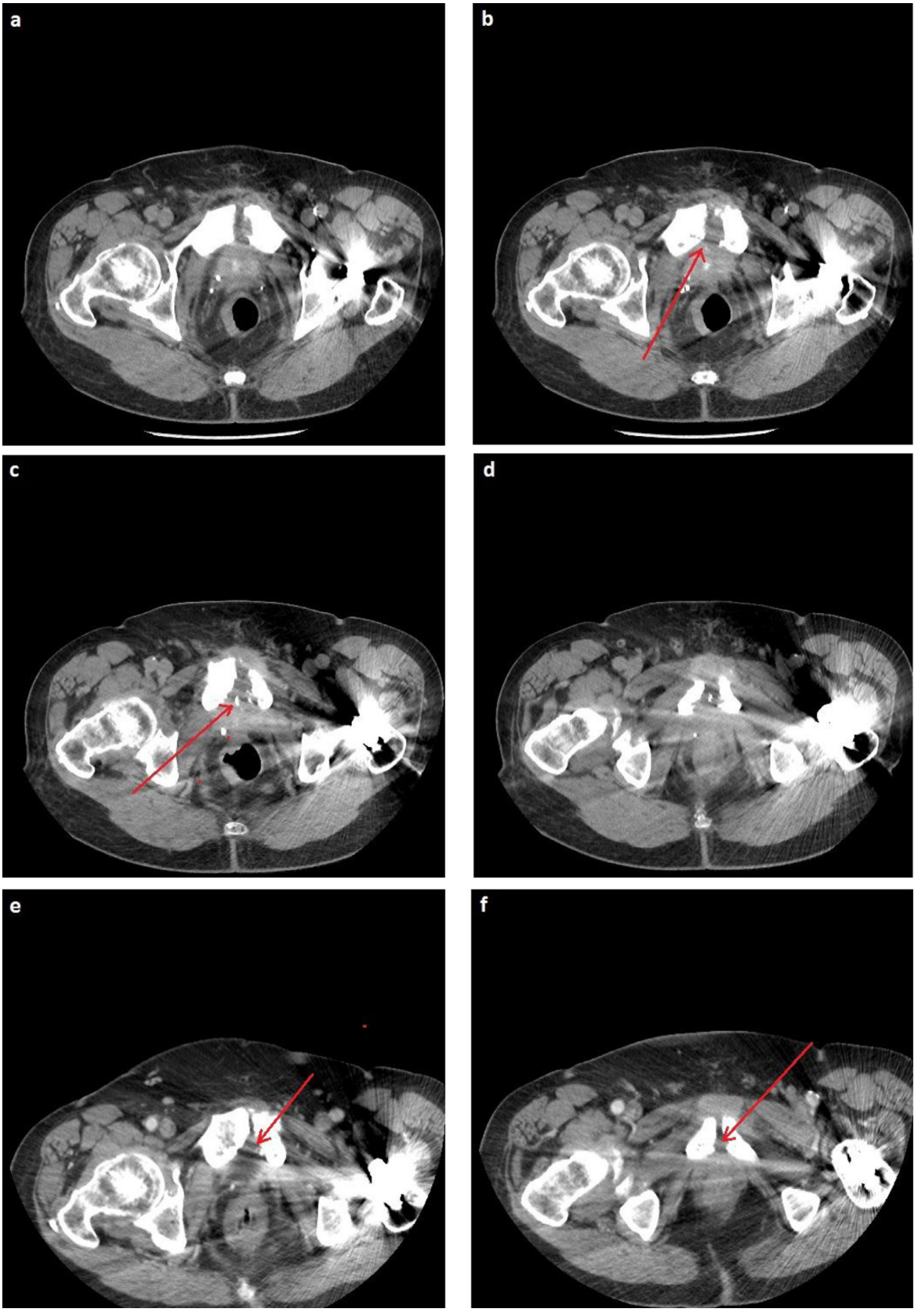

Figure 2. Patient status post-HIFU for prostate cancer. (a) and (b) Widening and inflammation of pubic symphysis with adjacent bony destruction *(red arrows)*. (c) and (d) Contrast demonstrating fistulous tract from prostatic urethra to pubic symphysis *(red arrow)*. (e) and (f) CT scan 4 years postsurgery demonstrating residual defect in pubic symphysis with resolution of fistula and adjacent osteomyelitis. (Color version available online.)

Table 2. Resistance patterns in organisms cultures from intraoperative bone/cartilage cultures

ID	Bacterial Culture	Antibiotic Resistance	Fungal Culture	Antifungal Resistance
1	Proteus spp.	Ciprofloxacin	No growth	NA
	Staphylococcus epidermidis	Ampicillin, Cefazolin, Clindamycin, Gentamicin, Levofloxacin, Penicillin		
2	Bacteroides fragilis	Not reported	Candida glabrata	nil
	Klebsiella pneumoniae	nil		
	Enterococcus spp.	Ampicillin		
3	Enterococcus spp.	Vancomycin	No growth	
	Aerococcus spp.	Not reported		
4	No growth	NA	Candida glabrata	Not reported
5	No growth	NA	Candida parapsilosis	Not reported
6	No growth	NA	Candida albicans	Not reported
7	No growth	NA	No growth	NA
8	No growth	NA	Candida glabrata	Not reported
9	Actinotignum schaalii	Not reported	No growth	NA
	Aerococcus spp.	Not reported		
	Lactobacillus spp.	Not reported		
10	No growth	NA	No growth	NA
11	Staphylococcus hemolyticus	Ampicillin, Oxacillin, Penicillin, Trimethoprim/Sulfamethoxazole	No growth	NA
12	Pseudomonas aeruginosa	Ciprofloxacin, Meropenem, Gentamicin, Tobramycin	No growth	NA
	Enterococcus spp.	Meropenem, Ciprofloxacin, Gentamicin, Tobramycin, Piperacillin/Tazobactam, Cefepime		

NA, not applicable.

surgery. We did not encounter any complications intraoperatively related to surgical plume or excessive heat from intracorporeal use of the laser. This can be prevented by instructing the assistant to avidly suction smoke generated from the laser fiber with intermittent irrigation to cool the tissue. High-flow insufflators can be helpful in this setting as well. The operating surgeon must take care not to inadvertently bend the laser stabilizing catheter with the robotic arms, which can potentially damage the laser fiber. The use of a laser stabilizing catheter is critical to the accuracy of the ablation (Supplement 4).

Given the rarity of this condition, there are limited datasets to compare the perioperative outcomes in patients undergoing definitive management. The majority of the literature is composed of case series involving small groups of patients managed with open cystectomy with urinary diversion and pubic symphysis debridement.[1-3,13] Reported lengths of stay are between 8 and 19.9 days compared to ours of 5 days.[2,3] Bugeja et al reported mean intraoperative blood loss of 1291 mL undergoing open debridement of the pubic symphysis with and without cystectomy.[2] This compares to estimated blood loss of 100 mL in our series. No patients in this series suffered any major postoperative complications at 30 and 90 days.

Reconstructive options in patients with UFS are usually limited to cystectomy and ileal conduit urinary diversion as these patients will often have been treated with various forms of pelvic irradiation.[2] In addition, there is inadequate length of healthy urethra above the external urethral sphincter making reconstruction in this setting near impossible.[2] This is compounded by patients' poor bladder capacity and tissue quality due to the impact of radiation induced endarteritis obliterans. Poor baseline bladder function in this series is reflected by the fact 10 of them were foley dependent with 11 treated for prostate cancer with multimodal therapy with some form of radiotherapy. Additionally, 10 (83.3%) patients in this series underwent prior treatment for bladder neck contractures or urethral strictures. All these factors play a role in the development and maintenance of fistulous connections between the urinary tract and pubic symphysis.[1,2] Kaufman et al described the use of a rectus abdominis muscle flap in 4 patients with prostate-symphyseal fistulas, thus avoiding the need for urinary diversion. At a median follow-up of 27 months, no patients had recurred. Robotic harvest and interposition of rectus abdominis muscle flaps has been demonstrated previously and could be a future direction for select cases of UFS.[14,15]

One patient in our series developed osteomyelitis of the pubic symphysis following PVP for BPH. Subsequently, the patient developed a bladder neck contracture and a perivesical abscess which was managed at an outside facility for 2 years prior to definitive surgery. Fistulas following PVP have been rarely reported in the literature to date.[16] Prolonged coagulation and capsular perforation during the procedure may lead to tissue necrosis beyond the point of tissue contact.[16] The increasing use of higher power laser generators may lead to greater energy delivery to prostate tissue. It has been demonstrated previously that PVP can result in a zone of hypovascular tissue beyond the treated surgical cavity.[17] This may encourage fistulous connection between the prostatic fossa and pubic

symphysis particularly following ablation of the anterolateral zone of the prostate.

A multidisciplinary approach is helpful in management of these cases. Our orthopedic surgery colleagues are present to help guide our debridement and intraoperative ablation of the diseased portion of pubic symphysis. Although debridement was typically limited to the infected portion of the pubic symphysis, it is critical to ensure complete resection of any sequestered necrotic tissue or nidus of infection. Complete resection of the pubic symphysis is only rarely necessary as this joint is not required to maintain function or independent ambulation. The pelvic ring stays structurally sound due to the robust posterior sacropelvic ligaments remaining intact. It has been previously shown that independent ambulation can be achieved following even very large internal pelvic resections without reconstruction, thus the extent of the osteomyelitis should dictate the extent of debridement.[18] Patients should be made aware that if large open segmental resections are required, the recovery process will likely be significantly lengthened. None of the patients in this series developed osteomyelitis requiring debridement beyond the immediate periarticular bone of the pubic symphysis. This is another potential advantage to this approach over the open approach of cutting down anteriorly into the infected region.

Consultation with infectious disease physicians is vital to ensure appropriate antibiotic use. Infections are consistently polymicrobial in the setting of prior pelvic malignancy.[5] It is not uncommon to encounter extensive antibiotic resistance, as was observed in some patients in this study. Conventional wisdom dictates that treatment involves a 6-week treatment course of antibiotics for patients with proven osteomyelitis of the pubic bones.[5] The order of diagnosis and treatment are not absolute, and a high degree of clinical suspicion is required despite failure to prove osteomyelitis on imaging or bone biopsy. In all cases, portions of the excised cartilage and bone were sent for culture to help guide postoperative treatment.

There are several limitations to this study. The most obvious is the small numbers of the study. The extremely rare presentation makes it difficult to conduct a meaningful analysis based on larger numbers in the setting of a single institution study. In addition, all robotic cases were performed by a single surgeon (EPC). Although patients were prospectively identified there are inherent selection biases associated with these patients. We cannot draw any conclusions as to whether this approach is superior to traditional open surgical approaches for this problem. Given the tertiary nature of our practice, we did not have complete medical records regarding prior radiation dosages and schemes, specifics of prior pathology or complete previous surgical history and interventions for the majority of our patients. The majority of patients presented to our practice at the end stage of conservative management and in severely debilitated states. In addition, though prior literature has consistently described pubic bone debridement as an integral component in managing this disease state, it is not known what the natural history of the disease would be if a patient underwent diversion without debridement. Lastly, an omental flap was not used during the index surgery in these cases and though most patients did not have a recurrence, it is possible that the individual who recurred due to radiation changes of the bowels may have benefited from an omental flap during surgery.

The main advantage of this paper is it is the first to describe the use of the Ho:YAG laser in a minimally invasive approach to surgical treatment of USF. Despite these limitations, 91.7% of patients had complete resolution of their fistula and associated symptoms at last follow-up. This is consistent with previous reported series of this condition demonstrating resolution of symptoms between 86.7% and 100%.[1,2] We also demonstrated medium term durability of this technique. In our practice, the orthopedic and urology service have decided prospectively to utilize the laser for debridement whether an open or robotic approach is utilized in the future. In some patients with less complex imaging findings (ie, small tract associated with the bladder) and reasonable bladder function, it is possible to excise the diseased components and avoid cystectomy.

CONCLUSION

This study describes the robot-assisted approach to treating pubic bone infection from a urinary tract source. USFs are rare entities that result in significant morbidity for patients and consistently fail conservative measures. Definitive surgical treatment with debridement of the pubic symphysis with concomitant cystectomy and urinary diversion is the only option remaining for these patients. A minimally invasive approach can reduce morbidity of treating these complex patients with less destabilization of the pelvic ring and reduced rehabilitation. In addition, the use of the Ho:YAG laser to ablate the pubic symphysis intracoroporeally is feasible, safe and durable in the medium term.

SUPPLEMENTARY MATERIALS

Supplementary material associated with this article can be found in the online version at https://doi.org/10.1016/j.urology.2019.08.049.

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EDITORIAL COMMENT

I congratulate the authors for presenting a minimally invasive approach to pubic symphyseal debridement with or without cystectomy in patients with urosymphyseal fistulas (USFs). Although a rare complication of prostate cancer radiotherapy treatment, USF and its associated osteomyelitis frequently result in debilitating pain, sepsis, decreased quality of life, and potentially increased mortality. The traditional treatment of this difficult problem has been to perform an open pubic bone debridement with either cystectomy and ileal conduit if the bladder is not salvageable, or to perform a USF closure with rectus muscle flap in the rare case of a salvageable lower urinary tract.[1-3]

The current study suggests that robot-assisted cystectomy and urinary diversion with concomitant holmium laser pubic bone debridement can be performed safely, while successfully treating the devastating sequela of pubic bone osteomyelitis. This is an important addition to the surgical literature in the era of robotic surgery, as it provides a minimally invasive option of managing pubic bone osteomyelitis. While opening the abdomen is always an option, there is certainly less morbidity associated with treating this robotically, with potentially less resection of otherwise healthy bone.

This is a heterogeneous group of patients with varying degrees of pubic bone pathology. Intraoperative judgment is an important factor in managing this crippling disease, but incredibly difficult due to how infrequently it is encountered. In this series, 16.7% of patient had recurrence of osteomyelitis, and one wonders whether this may have been avoided with either a more extensive bone debridement or use of an interposition flap (ie, omentum or rectus abdominis muscle). Based on this study, minimally invasive surgeons have a new technique to manage pubic bone osteomyelitis, but should not be hesitant to perform a more extensive bone resection or use an interposition flap in more extensive cases of osteomyelitis.

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https://doi.org/10.1016/j.urology.2019.08.050
UROLOGY 134: 133, 2019.

AUTHOR REPLY

We really appreciate the editorial feedback. This is a novel minimally invasive approach to a very complex problem. We agree that this pathology is extremely rare and requires aggressive treatment in order to definitively treat.

It is unknown if a more extensive debridement provides further advantage to excision and debridement of the specific fistulous tract, immediate surrounding area and diversion of urine with perioperative antibiotics. In our experience, we have found our orthopedic colleagues prefer the minimally invasive approach as it allows for maintenance of pelvic bone stability in addition to targeting the specific diseased area.

Regarding commentary about a 16.7% recurrence rate, only 1 patient had a true recurrence of osteomyelitis despite urinary diversion. The other patient had complications of colonic fistula as a result of their prior radiotherapy which resulted in osteomyelitis 13 months after their urinary diversion and pubic bone debridement surgery. Overall the recurrence rate from urinary tract was 8.3% which is consistent with the prior literature on this topic.

There are cases that may at times need more extensive bone debridement. The approach taken should be a decision made in conjunction with orthopedic surgeons. Overall, pubic bone osteomyelitis from urinary fistula is extremely difficult to treat following urinary diversion and debridement; and can take multiple courses of culture-specific antibiotics due to the polymicrobial nature of these infections.

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https://doi.org/10.1016/j.urology.2019.08.051
UROLOGY 134: 133–134, 2019.