ACCSCIENCE PUBLISHING

Advances in Radiotherapy & Nuclear Medicine

ORIGINAL RESEARCH ARTICLE

Sexual quality of life after stereotactic body radiotherapy and androgen deprivation therapy for prostate cancer: A single-institution observational study

Trinanjan Basu*, Jay Prakash Sahu, Shounak J. Kamat, Rohith R. Menon, Ghazala K. Roshan, Komal Parwani, and Parv Modi

HealthCare Global Cancer Center, Mumbai, Maharashtra, India

Abstract

Sexual quality of life (QOL) of prostate cancer (PCa) patients is severely impacted following curative treatment, yet remains infrequently discussed. The objective was to report the sexual QOL outcome of PCa patients treated by stereotactic body radiotherapy (SBRT) and androgen deprivation therapy (ADT). A total of 53 PCa patients across National Comprehensive Cancer Network risk categories with at least six months of follow-up were included in this study. Sexual symptom scores were assessed before SBRT and at 6, 12, 18, 24, and 36 months after treatment using the Expanded Prostate Cancer Index Composite for Clinical Practice questionnaire. The mean dose to the penile bulb (Dmean) and dose received by the bilateral neurovascular bundle (NVB) were documented. The mean sexual symptoms score was 5.06 pre-SBRT, increasing to 8.2 at 18 months post-SBRT and subsequently decreasing to 7.4 and 6.25 at 24 and 36 months post-SBRT, respectively, suggesting a potential recovery of sexual QOL beyond 2 years. The median Dmean to the penile bulb was 20.6 Gy, and median V34.4, V32, and V28 of the NVB were 88.4%, 96.7%, and 99.9%, respectively. SBRT combined with ADT was associated with a low observed frequency of biochemical failure and a decline in sexual QOL in this cohort. Larger prospective studies incorporating NVB-sparing strategies are needed to clarify the determinants of post-treatment sexual QOL.

Keywords: Prostate cancer; Stereotactic body radiotherapy; Sexual quality of life; Neurovascular bundles

***Corresponding author:**
Trinanjan Basu
(trinanjan.doctor@gmail.com)

Citation: Basu T, Sahu JP, Kamat SJ, *et al*. Sexual quality of life after stereotactic body radiotherapy and androgen deprivation therapy for prostate cancer: A single-institution observational study. *Adv Radiother Nucl Med*.
doi: 10.36922/ARNM026300034

Received: July 22, 2026

Revised: September 24, 2026

Accepted: October 9, 2026

Published online: October 22, 2026

Copyright: © 2026 Author(s). This is an Open-Access article distributed under the terms of the Creative Commons Attribution License, permitting distribution, and reproduction in any medium, provided the original work is properly cited.

Publisher's Note: AccScience Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

1. Introduction

Sexual function after treatment for prostate cancer (PCa) is influenced by treatment-related toxicities, age-related comorbidities, and psychosocial factors. Erectile dysfunction is a major adverse effect of PCa treatment that negatively impacts overall quality of life (QOL).[1] Sexual QOL in patients with PCa encompasses perceived sexual functioning, sexual satisfaction, and the extent to which sexual difficulties affect well-being.

In a 200 meta-analysis involving 54 studies, Robinson *et al.*[2] estimated that 55% of men maintained erectile function following external beam radiation therapy (EBRT).

The predicted probabilities of erectile dysfunction were 24% after brachytherapy alone, 45% after EBRT, 40% after brachytherapy combined with EBRT, 66% after nerve-sparing radical prostatectomy, 75% after standard radical prostatectomy, and 87% after cryotherapy.

While the successive implementation of intensity-modulated radiation therapy (IMRT) and image-guided radiation therapy[3] demonstrated their ability to mitigate both genitourinary (GU) and gastrointestinal (GI) toxicities[4], no significant improvement has been shown in sexual QOL over time, with erectile dysfunction rates ranging between 40% and 67% in new-era radiotherapy prospective trials.[5,6]

Sexual function is severely impacted by all traditional PCa treatment modalities and serves as a major source of patient distress. However, despite a growing body of literature, the specific impact of stereotactic body radiotherapy (SBRT) on sexual QOL remains less defined.[7] Recently, the PACE-B trial reported 2-year toxicity and QOL outcomes in PCa patients treated with SBRT (36.25 Gy in five fractions). Compared with IMRT, SBRT demonstrated noninferiority in safety and treatment outcomes.[8] This study aimed to report sexual QOL outcomes using the Expanded Prostate Cancer Index Composite for Clinical Practice (EPIC-CP) questionnaire in patients with intermediate-, high-, or very-high-risk PCa, as well as patients with oligometastatic disease treated with SBRT and androgen deprivation therapy (ADT). The secondary objective was to document dosimetric parameters of neurovascular bundles (NVBs) and the penile bulb (PB). EPIC-CP is a short, 16-item patient-reported tool used to assess health-related QOL and treatment side effects in PCa patients during routine clinical care. This questionnaire evaluates symptom severity and functional outcomes over the past 4 weeks at the point of care. It includes five domains: urinary incontinence, urinary obstruction, bowel health, sexual health, and hormonal health. Each domain contains 3 scored items and has a score ranging from 0 to 12, with higher scores indicating worse symptoms. The maximum overall score is 60. The sexual health domain has questions about the ability to reach orgasm (climax), quality of erection, and how problematic the sexual function is.

2. Methods and materials

2.1. Patient selection

This single-institution retrospective observational study analyzed prospectively collected clinical and patient-reported outcome data from a departmental database. We included biopsy-proven PCa patients in intermediate- to high- or very high-risk National Comprehensive Cancer Network (NCCN) categories, with oligometastatic disease, treated with radical-intent SBRT and ADT (per clinical indications), with at least six months of follow-up. Patients with a history of previous radiotherapy and polymetastatic disease were excluded from the study. Consecutive eligible patients between May 2020 and December 2025 were included. Patient characteristics, baseline prostate-specific antigen (PSA), and pre-SBRT International Prostate Symptom Score (IPSS) were collected. Sexual symptom scores were collected prior to SBRT using the EPIC-CP questionnaire.[9] Acute and late GU and GI toxicity were documented as per the Radiation Therapy Oncology Group (RTOG).

2.2. Treatment delivery

All patients were simulated in the supine position with hands above head using a Vac-Lok immobilization device with standard bladder and bowel protocol. Non-contrast as well as contrast-enhanced planning computed tomography scans were acquired with 1.25 mm slice thickness. Contouring was performed per the European Society for Radiotherapy and Oncology Advisory Committee on Radiation Oncology Practice guideline after image registration with magnetic resonance imaging (MRI) of the prostate.[10] Dose constraints for the rectum, bladder, and bowel were applied in accordance with the PRIME trial protocol.[11] Bilateral NVBs were retrospectively delineated according to the contouring approach described for the POTEN-C trial[12] (Figure 1–3). All patients received a uniform SBRT schedule delivering 36.25 Gy in five fractions to the prostate and seminal vesicles (extent of seminal vesicles as per risk category), 25 Gy in five fractions to bilateral pelvic nodes for high- and very-high-risk groups and oligometastatic disease, and 30 Gy in five fractions to the oligometastatic site. Radiotherapy was delivered using volumetric modulated arc therapy with 6-MV flattening-filter-free beams on a linear accelerator equipped with six-degrees-of-freedom couch correction. Fractions were delivered either on alternate days or once weekly. The mean dose to the PB (Dmean) and the percentages of NVB volume receiving at least 34.4, 32, and 28 Gy (V34.4 Gy, V32 Gy, V28 Gy) were recorded.

2.3. Follow-up

Patients underwent follow-up assessments every 3 months during the first 2 years after SBRT and every 6 months thereafter. All patients underwent serum PSA and routine blood investigations every three months for two years, followed by every six months after completing SBRT. EPIC-CP questionnaire data for sexual symptoms score were collected every 6 months for 2 years, then at 36 months of follow-up.

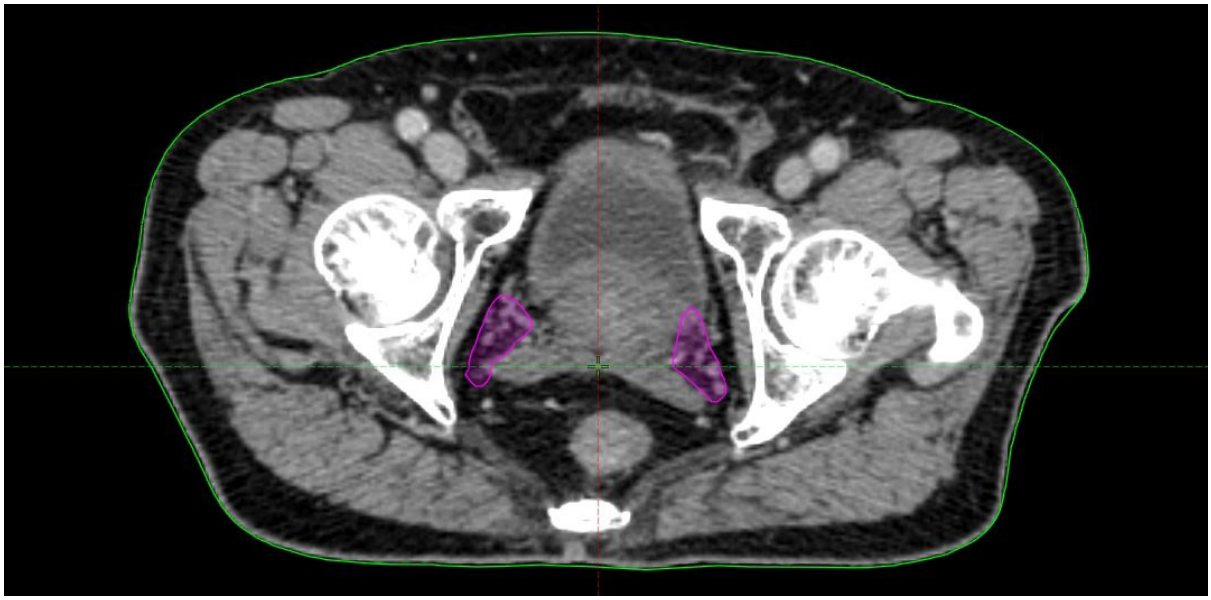


Figure 1. Contouring of neurovascular bundles (pink color) at the level of the base of the prostate in an axial planning computed tomography scan

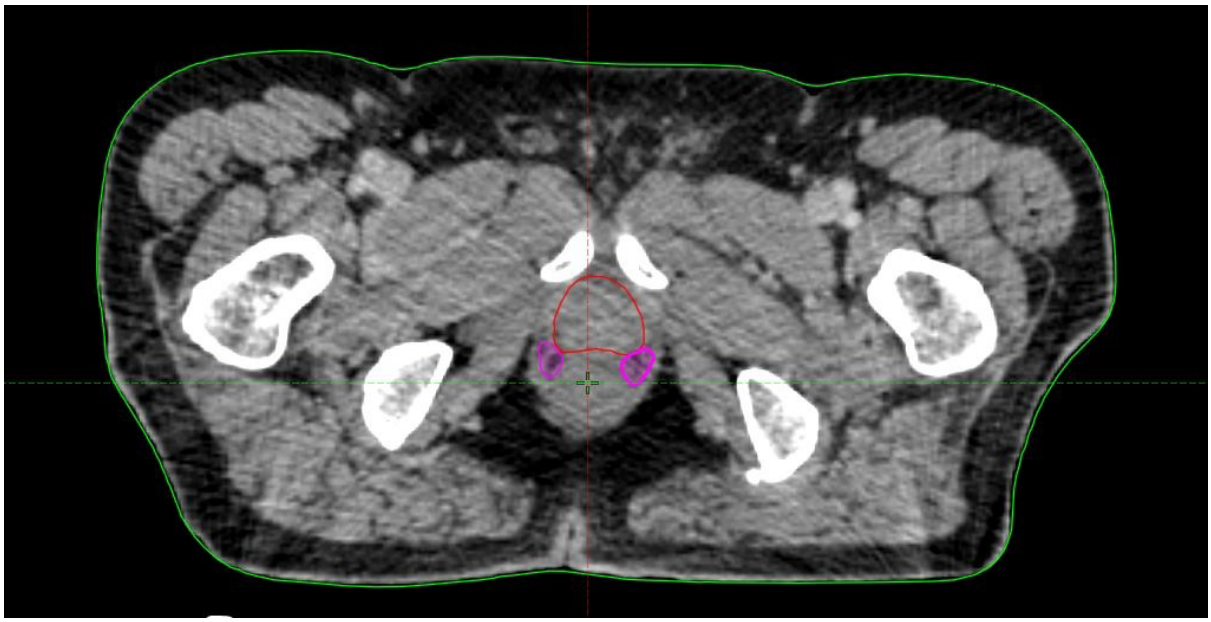


Figure 2. Contouring of neurovascular bundles at the level of the apex of the prostate in an axial planning computed tomography scan

3. Results

3.1. Patient characteristics

A total of 53 patients were included in the analysis. The median age was 71 years (range: 45–88 years). The baseline median serum PSA was 20.42 ng/ml (range: 2.9–440 ng/ml) and pre-SBRT serum PSA was 0.64 ng/ml (range: 0.01–63.48 ng/ml). As per the 8th edition of the American Joint Committee on Cancer Tumor–Node–Metastasis staging system, the distribution of T stages was as follows: T2c (35.8%), T3a (9.4%), T3b (32.1%), and T4 (3.8%). Regional lymph node involvement was present in 34% of patients,

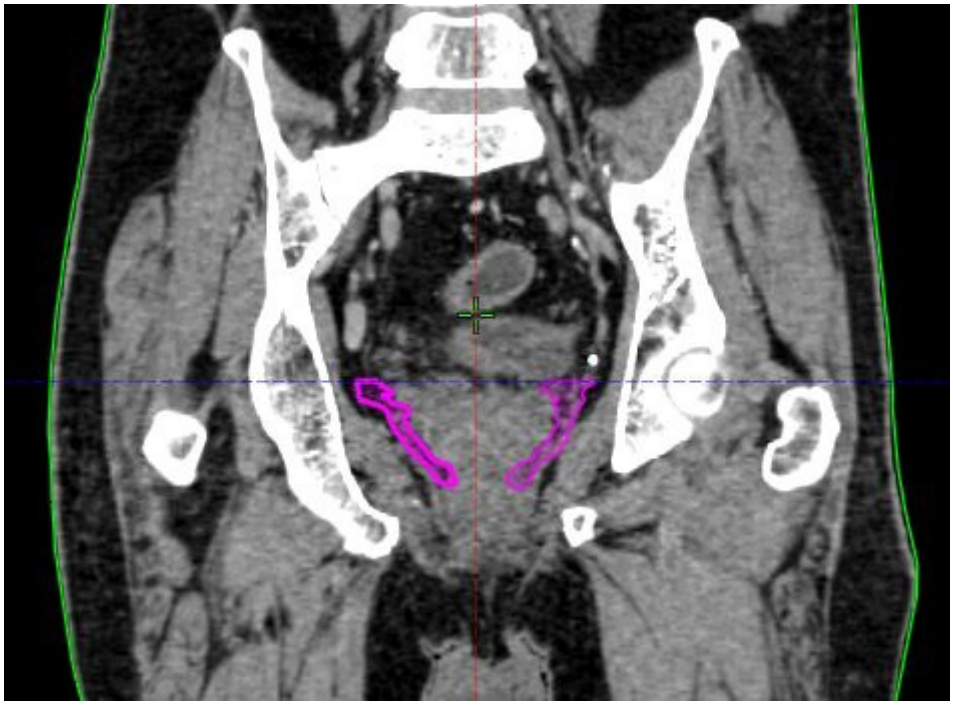


Figure 3. Coronal view of neurovascular bundle contouring

and 30.2% had oligometastatic disease. Gleason scores 7 and 8 were observed in 43.4% and 32.1% of patients, respectively. A total of 58.5% of patients were classified as Gleason grade group 4. By NCCN risk category, 7.5% were favorable intermediate risk, 7.5% unfavorable intermediate risk, 62.3% high risk, and 22.6% were very high risk. Baseline IPSS was documented, which showed that 50.9% of patients had moderate IPSS. Of the patients, 7.5% underwent orchidectomy, 13.2% received short-course ADT for 6–9 months, and 79.2% received long-course ADT for at least two years (Table 1).

Table 1. Patient characteristics and dosimetry

Parameters	Value
Median age	71 years (range: 45–88)
International Prostate Symptom Score	
Low	39.6%
Moderate	50.9%
Severe	9.4%
T stage	
T2a	5.7%
T2c	35.8%
T3a	9.4%
T3b	32.1%
T4	3.8%
N stage	
N0	66%
N1	34%
M stage	
M0	69.8%
M1	30.2%
National Comprehensive Cancer Network risk stratification	
Intermediate favorable	7.5%
Intermediate unfavorable	7.5%
High	62.3%
Very high	22.6%
Grade group	
3	34%
4	58.5%
5	7.5%
Baseline median prostate-specific antigen	20.4 (range: 2.9–440)

(*Cont'd...*)

Table 1. (*Continued*)

Parameters	Value
Pre-stereotactic body radiotherapy median prostate-specific antigen	0.64 (0.01–63.48)
Androgen deprivation therapy	
Short course	13.2%
Long course	79.2%
Orchidectomy	7.5%
Median Dmean penile bulb	20.6 Gy (range: 9.5–29.6)
Neurovascular bundle	
V34.4 Gy	88.4% (range: 83%–91.3%)
V32 Gy	96.7% (range: 94.4%–99.6)
V28 Gy	99.9% (range: 99.7%–100%)

3.2. Dosimetry

The median Dmean was 20.6 Gy (range: 9.5–29.6 Gy), satisfying protocol organ-at-risk (OAR) constraints. Conversely, median V34.4, V32, and V28 for the NVBs were 88.4% (range: 83%–91.3%), 96.7% (range: 94.4%–99.6%), and 99.9% (range: 99.7%–100%), respectively, failing standard constraints (V34.4 Gy < 60%, V32 Gy < 70%, V28 < 90%) (Table 1).

3.3. Acute toxicity

We evaluated all patients at two weeks and three months post-treatment. At each visit, patients were assessed for bowel and bladder toxicity using RTOG criteria. Overall, GU toxicity Grade 1 and Grade 2 were observed in 49.1% and 7.5% of patients, respectively. Overall, GI toxicity Grade 1 and Grade 2 were observed in 45.3% and 5.7% of patients, respectively. There was no Grade 3–4 toxicity observed (Table 2).

Table 2. Acute and late toxicity profile

Profile	Value
Acute toxicity	
Gastrointestinal (GI) Grade 1	45.3%
GI Grade 2	5.7%
Genitourinary (GU) Grade 1	49.1%
GU Grade 2	7.5%
Late toxicity	
GI Grade 1	13.2%
GI Grade 2	3.8%
GU Grade 1	22.6%
GU Grade 2	17.0%
GU Grade 3	1.9%

3.4. Sexual quality of life assessed using the EPIC-CP questionnaire

The mean sexual symptom score increased from 5.06 at baseline to a peak of 8.2 at 18 months, before decreasing to 7.4 and 6.25 at 24 and 36 months, respectively. Although the score decreased after 18 months, it remained higher than the baseline value at 36 months (Figure 4).

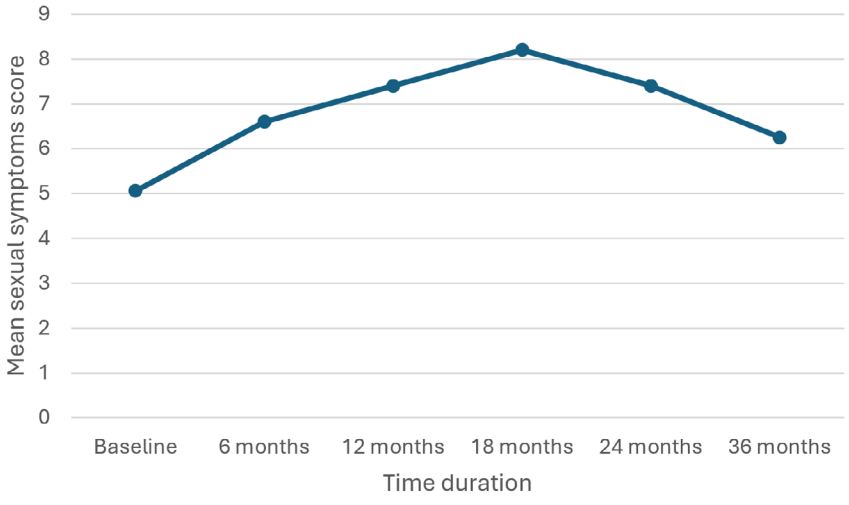


Figure 4. Mean sexual symptoms score at different time intervals

At baseline, 26.4% of patients reported a good ability to reach orgasm. This proportion decreased to 7.5% at 12 months and 1.9% at 24 months before increasing to 3.8% at 36 months. Conversely, 15.1% of patients reported a very poor ability to reach orgasm at baseline, increasing to 26.4% at 12 months before decreasing to 13.2% and 7.5% at 24 and 36 months, respectively, indicating worsening of ability to reach orgasm until 24 months and slight improvement at the end of 36 months (Table 3).

In terms of quality of erection, only 26.4% of patients reported erections firm enough for intercourse at baseline, decreasing to 1.9% at six months. At baseline, 26.4% of patients reported erections firm enough for masturbation. This proportion was 37.7% at six months, 20.8% at 12 months, 9.4% at 18 months, and 11.3% at 24 months, suggesting progressive deterioration in erectile function over the 24-month follow-up period (Table 4).

Regarding overall sexual function, 20.8% of patients reported no problems before SBRT, compared with 7.5% at 12 months and 3.8% at both 24 and 36 months. No patient reported major problems with overall sexual function at baseline; however, this proportion increased to 9.4% at 12 months and 11.3% at 18 months, before gradually decreasing to 7.5% at 24 months and 1.9% at 36 months. These findings suggested that sexual QOL deteriorated until 18 months after SBRT, followed by gradual improvement (Table 5).

The mean sexual symptoms score at 12 months was significantly correlated with the baseline score (p = 0.02, one-way analysis of variance test), indicating the direct relationship between baseline sexual QOL and sexual QOL after 12 months of treatment.

3.5. Late toxicity

Grade 2 GU toxicity (mostly severe dysuria, urgency, or obstructed flow) occurred in nine (17.0%) patients, and Grade 3 toxicity occurred in one patient only (1.9%). Late Grade 2 GI toxicity occurred in 3.8% of patients, and there was no Grade 3 GI toxicity (Table 2).

3.6. Prostate-specific antigen and biochemical control and follow-up

The median follow-up was 22 months (range: 7–66 months) with seven patients (13.2%) lost to follow-up. At a median follow-up of 22 months, biochemical failure was documented in 3 patients (5.7%), while 50 patients (94.3%) had no documented biochemical failure. Ten patients (18.9%) died due to age/comorbidities. No disease-related death was documented (Table 6).

4. Discussion

Sexual health is an important aspect of QOL among men treated for PCa.[13] Numerous factors other than PCa treatment affect erectile function, including age, comorbidities (diabetes, neurological disease), lifestyle (smoking, excessive alcohol consumption), and drug

Table 3. Ability to reach orgasm at different time intervals

Climax	Baseline	6 months	12 months	18 months	24 months	36 months
Very good	7 (13.2%)	2 (3.8%)	0	0	0	0
Good	14 (26.4%)	9 (17%)	4 (7.5%)	0	1 (1.9%)	2 (3.8%)
Fair	12 (22.6%)	14 (26.4%)	16 (30.2%)	12 (22.6%)	10 (18.9%)	8 (15.1%)
Poor	12 (22.6%)	7 (13.2%)	10 (18.9%)	11 (20.8%)	6 (11.3%)	2 (3.8%)
Very poor	8 (15.1%)	17 (32.1%)	14 (26.4%)	11 (20.8%)	7 (13.2%)	4 (7.5%)
Total numbers of patients	53	49	44	34	24	16

Table 4. Quality of erection at different time intervals

Quality of erection	Baseline	6 months	12 months	18 months	24 months	36 months
Firm enough for intercourse	14 (26.4%)	1 (1.9%)	0	0	0	1 (1.9%)
Firm enough for masturbation	14 (26.4%)	20 (37.7%)	11 (20.8%)	5 (9.4%)	6 (11.3%)	6 (11.3%)
Not firm enough for sexual activity	17 (32.1%)	12 (22.6%)	17 (32.1%)	15 (28.3%)	10 (18.9%)	4 (7.5%)
Not at all	8 (15.1%)	16 (30.2%)	16 (30.2%)	14 (26.4%)	8 (15.1%)	5 (9.4%)
Total	53	49	44	34	24	16

Table 5. Overall sexual function problem score at different time intervals

Overall sexual function problem	Baseline	6 months	12 months	18 months	24 months	36 months
No problem	11 (20.8%)	4 (7.5%)	4 (7.5%)	3 (5.7%)	2 (3.8%)	2 (3.8%)
Very small problem	16 (30.2%)	13 (24.5%)	4 (7.5%)	4 (7.5%)	5 (9.4%)	5 (9.4%)
Small problem	17 (32.1%)	20 (37.7%)	15 (28.3%)	9 (17.0%)	6 (11.3%)	5 (9.4%)
Moderate problem	9 (17%)	10 (18.9%)	16 (30.2%)	12 (22.6%)	7 (13.2%)	3 (5.7%)
Big problem	0	2 (3.8%)	5 (9.4%)	6 (11.3%)	4 (7.5%)	1 (1.9%)
Total	53	49	44	34	24	16

history (antihypertensives, antidepressants). Hence, a significant number of PCa patients experience erectile difficulties prior to diagnosis. A previous study had a series of 802 patients with PCa evaluated for sexual function before starting any treatment and reported that only 69% of patients were potent (defined as achieving an erection sufficient for penetration), with a median age of 66 years. Additionally, receiving a diagnosis of PCa is likely to result in emotional stress and affect both libido and erectile function.[14-16]

Table 6. Treatment outcome and follow-up status

Measures	Value
Biochemically controlled	
Yes	94.3%
No	5.7%
Status at last follow-up	
Alive	67.9%
Dead	18.9%
Lost to follow-up	13.2%

The available evidence suggests that sexual and erectile dysfunction can occur following different treatment modalities, including surgery, radiotherapy, and hormonal therapy. Following radical prostatectomy, erectile dysfunction is particularly common, with approximately 90% of men reported to develop moderate-to-severe dysfunction within the first year. Hormonal therapy may further contribute to worsening sexual function, with reduced sexual activity. The impact of these changes may extend beyond sexual function itself, affecting intimacy, relationship satisfaction, and overall well-being. The reviewed evidence also suggests that younger patients may find it more difficult to adjust to treatment-related changes in sexual function. Therefore, discussion of potential sexual consequences before treatment, along with appropriate counseling and support for both patients and their partners, should form an integral part of PCa survivorship care.

Erectile difficulties are frequently associated with radiotherapy (both external radiotherapy and brachytherapy). The time course of dysfunction is different than erectile dysfunction after radical prostatectomy. Erectile dysfunction following radiotherapy is primarily attributable to neurovascular damage, which tends to progress over time, resulting in erectile dysfunction rates of up to 50%–60% within 2–3 years post-treatment.[17]

A study compared radiotherapy modalities using previously validated prospective models to predict 24-month functional erections after EBRT and brachytherapy.[15] Model-predicted rates for this cohort of men were 37% (95% CI: 33%–40%) with EBRT and 32% (95% CI: 28%–35%) with brachytherapy. Another study reported a functional erection rate of 34% (95% CI: 29%–40%) after SBRT, which was not statistically significantly different from the corresponding estimates after EBRT ($p = 0.31$) or brachytherapy.[18,19]

Rucinska and Kieszkowska-Grudny[20] compared the impact of radiotherapy techniques (three-dimensional conformal radiotherapy or modulated radiotherapy) and dose-fractionation of radiotherapy (conventional or hypofractionated radiotherapy) on sexual QOL using the prostate cancer-specific EORTC QLQ-PR25 questionnaire. After short-term analysis, hypofractionated radiotherapy (SBRT) was found to be an attractive treatment option in terms of sexual QOL in comparison to conventional fractionation. The emerging role of liquid biopsy and minimally invasive biomarkers in the precision management of PCa, particularly in the context of treatment-related sexual dysfunction and long-term quality of life, is also being studied and is under investigation.

To evaluate the impact of prostate SBRT on sexual function, it is important to assess the effect on sexuality-related QOL. The EPIC questionnaire addresses this component by asking patients about their ability to reach orgasm, quality of erection, and the severity of sexual

dysfunction (or lack of sexual function) in the previous four weeks. Other available tools in the literature to assess sexual QOL in PCa patients are the EPIC-26[21] and the 5-item version of the International Index of Erectile Function (IIEF-5), also known as the Sexual Health Inventory for Men.[22]

Katz *et al.*[23] concluded that EPIC sexual QOL declined at 6–12 months and remained stable thereafter. Our study also showed an increase in the overall sexual symptoms score compared to the pre-SBRT score. The mean score increased until 18 months and subsequently declined through 36 months, indicating worsening sexual QOL from baseline to 18 months after SBRT, followed by partial improvement.

Wiegner and King[1] found that 22% had difficulty reaching orgasm at baseline, which increased to 36% and 39% at 12 months and 20 months, respectively, while in our pre-SBRT study, 37.7% had poor to very poor orgasm, which increased to 45.3% at 12 months. Poor baseline orgasmic function may have been influenced by patient age and the initiation of ADT prior to SBRT. In terms of quality of erection, the study found that 31% of patients had poor erection and increased to 40% after 12 months, while 11.1% had poor erection pre-SBRT and increased to 30.2% after 12 months. At the last follow-up, 25% of the men considered sexual function a moderate or big problem. In our study, 17% had a moderate problem, and no patient had a big problem pre-SBRT. However, 39.6% of patients at 12 months and 20.7% of patients at 24 months reported moderate to big problems in overall sexual function. Only 7.6% of patients had moderate to big problems at the last follow-up. In our study, patients' reported problems with overall sexual function were assessed separately from their ability to reach climax and the quality of their erections.

Tree *et al.*[8] also reported the same trajectory change in sexual QOL, reflecting a characteristic transient dip and subsequent stabilization beyond 12–24 months post-SBRT. In contrast to our study, a phase II trial investigated the toxicity and patient-reported QOL (EPIC-26 and IIEF-5) in patients treated with prostate SBRT with a simultaneous focal boost to an MRI-defined intraprostatic lesion and reported no significant change in patient-reported sexual and hormonal QOL at any follow-up time point.[24]

All penile structures being located closely to one another, the dose delivered to the PB can be a surrogate for the dose delivered to other penile structures (crura, corpora cavernosa, and corpus spongiosum).[25] There are few studies that have demonstrated a correlation between the dose delivered to any of the penile structures and the onset of erectile dysfunction.[26-30] Few studies have described the impact of the dose delivered to the PB on sexual function after SBRT. Wiegner and King[1] reported low doses delivered to the PB with SBRT, with a median dose of 13.06 Gy. Obayomi-Davies *et al.*[31] also reported sexual outcomes after prostate SBRT, and the mean percentage of PB receiving 29.5 Gy was 7%. Achard *et al.*[32] concluded that, for the dose delivered to the PB, no statistically significant difference was observed between patients who developed erectile dysfunction and those who had no erectile dysfunction after SBRT. No study could reach the conclusion that PB dose volume parameters were associated with the onset of erectile dysfunction, which raises the possibility that other sexual organs may be compromised after PCa SBRT. In our study, the median PB dose was 20.6 Gy, similar to the available literature, but Dmean PB was not statistically correlated with the sexual symptoms score.

Hwang *et al.*[33] described that rectal hydrogel spacer placement shifted NVB away from the prostate, resulting in a 10% decrease in NVB V34.4 Gy in non-NVB-sparing plans ($p < 0.01$). NVB-sparing treatment planning reduced the NVB V34.4 by 16% without the spacer ($p < 0.01$) and 25% with spacer ($p < 0.001$), which may significantly reduce radiation-induced erectile dysfunction without compromising planning target volume coverage and OAR endpoints; however, in our cohort, no active interventions (such as hydrogel spacers or formal NVB-sparing optimization) were employed. Consequently, standard NVB dose constraints were consistently exceeded, highlighting the clinical need to integrate hydrogel spacers and dedicated NVB-sparing optimization in future protocols. Teunissen *et al.*[34] assessed the feasibility of NVB sparing using magnetic resonance–guided radiotherapy (MRgRT) in men with preserved erectile function diagnosed with intermediate-risk PCa, and concluded that NVB sparing was feasible bilaterally in 20.0% and unilaterally in 68.0%. The same team further assessed both feasibility of NVB sparing and its impact on other sexual structures (PB, NVB, internal pudendal arteries [IPAs], and corpus cavernosum) using MRgRT[35]. The median planned dose to the NVB, IPAs, and corpus cavernosum was significantly lower in the NVB plans than in the standard plans. Constraints to the NVB and IPAs were met bilaterally and at least unilaterally in 40% and 95% of patients, respectively, and in 40% and 5% of patients, respectively, demonstrating the feasibility of a sparing approach for the majority of the patients.

Donovan *et al.*[36] reported that patients receiving ADT experienced progressive deterioration in sexual function and increasing sexual bother over time, with sexual function never returning to baseline levels. In our study, the majority (79.2%) of patients receiving long-course ADT remained a contributing factor in the worsening of sexual QOL over time. In our study, all patients received

neoadjuvant as well as concurrent ADT (except for orchiectomy patients), leading to an inability to conclude the individual impact of SBRT or ADT on sexual QOL. Saxby *et al.*[37] discussed the potential importance of ADT timing in relation to SBRT for oligometastatic PCa and emphasized the need to balance treatment efficacy against ADT-related adverse effects.

In the PACE B trial[38], sexual subdomain scores declined between 2 and 5 years, with no evidence of significant differences between the conventional radiotherapy and SBRT groups at 5 years. In our study, the mean sexual symptom score increased at 2 years compared to baseline but decreased slightly by 3 years, suggesting some improvement in sexual QOL after 2 years.

van As *et al.*[39] concluded that prostatectomy participants had clinically and statistically significantly poor 24-month EPIC sexual domain scores compared to SBRT. A higher proportion of prostatectomy participants reported a reduction from baseline in sexual domain scores as compared to SBRT. At 24 months, 10 of 30 patients (33%) in the prostatectomy group and 8 of 45 patients (18%) in the SBRT group reported moderate or severe problems with sexual function. In our study, 20.7% of patients reported moderate or big problems, which was comparable to the SBRT arm in this study.

A study by Poon *et al.*[40] reported that acute grade ≥ 2 GI toxicity occurred in 8.3% and grade ≥ 2 GU toxicity in 23.3%, while in our study acute grade ≥ 2 GI toxicity was only 5.7% and grade ≥ 2 GU toxicity was 7.5%, demonstrating lower GI toxicity and GU toxicity. A study by Martinez *et al.*[41] reported that late grade GI toxicity occurred in four patients (4%), including three cases of rectal bleeding and one case of fecal incontinence. Late grade 2 GU toxicity occurred in 5% of patients. No grade ≥ 3 GI or GU toxicity was observed. In our study, late grade 2 GI toxicity occurred in 3.8% and grade 2 GU toxicity in 17%, and 1.9% of patients had grade 3 GU toxicity.

This study is limited by a relatively small sample size. However, it provides valuable longitudinal insights into sexual QOL of PCa patients after SBRT and ADT, a topic scarcely addressed in the existing literature. All studies of erectile dysfunction and sexual QOL are constrained by how the questionnaires are designed. As erectile dysfunction and sexual QOL are not easily quantified or measured, comparing different series should be done with caution because the wording of questionnaires can be subject to interpretation.

5. Conclusion

A substantial proportion of patients had mild or no erectile dysfunction at baseline but experienced worsening sexual QOL following SBRT and ADT. Pretreatment age and baseline sexual QOL are powerful predictors of long-term erectile function. The technical challenge of sparing NVB for high-risk PCa patients combined with the effect of ADT remains a concern. However, PB doses remained within acceptable protocol limits, indicating that post-treatment sexual dysfunction is multifactorial and not governed solely by PB dosimetry. Late recovery of sexual function to a modest extent remains a plausible possibility. There are limitations in documentation of sexual QOL by EPIC-CP. Future prospective documentation and pragmatic sparing of NVB can highlight specific issues related to sexual QOL.

Acknowledgments

We would like to thank all our colleagues, staff, and patients encountered in this journey.

Funding

None.

Conflict of interest

The authors declare that they have no competing interests.

Author contributions

Conceptualization: Trinanjan Basu, Jay Prakash Sahu
Formal analysis: Shounak J. Kamat, Rohith R. Menon, Ghazala K. Roshan
Investigation: Trinanjan Basu, Jay Prakash Sahu
Methodology: Jay Prakash Sahu, Komal Parwani
Writing–original draft: Jay Prakash Sahu
Writing–review & editing: Trinanjan Basu, Jay Prakash Sahu, Komal Parwani, Parv Modi

Ethics approval and consent to participate

The study was reviewed by the HCG Cancer Centre-Institutional Ethics Committee, which determined that it was exempt from formal ethics approval. No approval or exemption reference number was issued. Informed consent was obtained from all participating patients.

Consent for publication

We obtained individual consent from each patient for publication.

Availability of data

Data are available upon request from the corresponding author.

References

1. Wiegner EA, King CR. Sexual function after stereotactic body radiotherapy for prostate cancer: results of a prospective

clinical trial. *Int J Radiat Oncol Biol Phys*. 2010;78(2):442-448.

doi: 10.1016/j.ijrobp.2009.07.1748

2. Robinson JW, Moritz S, Fung T. Meta-analysis of rates of erectile function after treatment of localized prostate carcinoma. *Int J Radiat Oncol Biol Phys*. 2002;54(4):1063-1068.

doi: 10.1016/S0360-3016(02)03030-4

3. Latorzeff I, Mazurier J, Boutry C, Dudouet P, Richaud P, de Crevoisier R. Apports de la radiothérapie avec modulation d'intensité guidée par l'image dans les cancers prostatiques [Benefit of intensity modulated and image-guided radiotherapy in prostate cancer]. *Cancer Radiother*. 2010;14(6-7):479-487. [In French]

doi: 10.1016/j.canrad.2010.06.013

4. Stuk J, Vanasek J, Odrazka K, *et al.* Image-guided radiation therapy produces lower acute and chronic gastrointestinal and genitourinary toxicity in prostate cancer patients. *J BUON*. 2021;26(3):940-948.

5. Hall WA, Deshmukh S, Bruner DW, *et al.* Quality of Life Implications of Dose-Escalated External Beam Radiation for Localized Prostate Cancer: Results of a Prospective Randomized Phase 3 Clinical Trial, NRG/RTOG 0126. *Int J Radiat Oncol Biol Phys*. 2022;112(1):83-92.

doi: 10.1016/j.ijrobp.2021.07.004

6. Beckendorf V, Guerif S, Le Prisé E, *et al.* 70 Gy versus 80 Gy in localized prostate cancer: 5-year results of GETUG 06 randomized trial. *Int J Radiat Oncol Biol Phys*. 2011;80(4):1056-1063.

doi: 10.1016/j.ijrobp.2010.03.049

7. Loi M, Wortel RC, Francolini G, Incrocci L. Sexual Function in Patients Treated With Stereotactic Radiotherapy For Prostate Cancer: A Systematic Review of the Current Evidence. *J Sex Med*. 2019;16(9):1409-1420.

doi: 10.1016/j.jsxm.2019.05.019

8. Tree AC, Ostler P, van der Voet H, *et al.* Intensity-modulated radiotherapy versus stereotactic body radiotherapy for prostate cancer (PACE-B): 2-year toxicity results from an open-label, randomised, phase 3, non-inferiority trial. *Lancet Oncol*. 2022;23(10):1308-1320.

doi: 10.1016/S1470-2045(22)00517-4

9. Chang P, Szymanski KM, Dunn RL, *et al.* Expanded Prostate Cancer Index Composite for Clinical Practice: development and validation of a practical health related quality of life instrument for use in the routine clinical care of patients with prostate cancer. *J Urol*. 2011;186(3):865-872.

doi: 10.1016/j.juro.2011.04.085

10. Salembier C, Villeirs G, De Bari B, *et al.* ESTRO ACROP consensus guideline on CT- and MRI-based target volume delineation for primary radiation therapy of localized prostate cancer. *Radiother Oncol*. 2018;127(1):49-61.

doi: 10.1016/j.radonc.2018.01.014

11. Murthy V, Mallick I, Gavarraju A, *et al.* Study protocol of a randomised controlled trial of prostate radiotherapy in high-risk and node-positive disease comparing moderate and extreme hypofractionation (PRIME TRIAL). *BMJ Open*. 2020;10(2):e034623.

doi: 10.1136/bmjopen-2019-034623

12. Leiker AJ, Hassan Rezaeian N, Laine AM, *et al.* Prostate Cancer Neurovascular Element Sparing with Stereotactic Ablative Radiation Therapy (SAbR): A Pilot Dosimetric Study for the POTEN-C Trial. *International Journal of Radiation Oncology Biology Physics*. 2018;102(3):e125-e125.

doi: 10.1016/j.ijrobp.2018.07.335

13. Arif R, Hami H, Sennani S, *et al.* Long-term impacts of prostate cancer treatments on sexual function and psychological well-being: A comprehensive narrative review. *Eur Psychiatry*. 2025;68(S1):S877.

doi: 10.1192/j.eurpsy.2025.1779

14. Vale J. Erectile dysfunction following radical therapy for prostate cancer. *Radiother Oncol*. 2000;57(3):301-305.

doi: 10.1016/s0167-8140(00)00293-0

15. Potters L, Torre T, Fearn PA, Leibel SA, Kattan MW. Potency after permanent prostate brachytherapy for localized prostate cancer. *Int J Radiat Oncol Biol Phys*. 2001;50(5):1235-1242.

doi: 10.1016/s0360-3016(01)01578-4

16. Siegel T, Moul JW, Spevak M, Alvord WG, Costabile RA. The development of erectile dysfunction in men treated for prostate cancer. *J Urol*. 2001;165(2):430-435.

doi: 10.1097/00005392-200102000-00019

17. Potosky AL, Legler J, Albertsen PC, *et al.* Health outcomes after prostatectomy or radiotherapy for prostate cancer: results from the Prostate Cancer Outcomes Study. *J Natl Cancer Inst*. 2000;92(19):1582-1592.

doi: 10.1093/jnci/92.19.1582

18. Alemozaffar M, Regan MM, Cooperberg MR, *et al.* Prediction of erectile function following treatment for prostate cancer. *JAMA*. 2011;306(11):1205-1214.

doi: 10.1001/jama.2011.1333

19. Dess RT, Hartman HE, Aghdam N, *et al.* Erectile function after stereotactic body radiotherapy for localized prostate cancer. *BJU Int*. 2018;121(1):61-68.

doi: 10.1111/bju.13962

20. Rucinska M, Kieszkowska-Grudny A. Quality of Life and Sexual Activity after Stereotactic Hypofractionated Radiotherapy of Prostate Cancer Patients. *J Integr Oncol*. 2016;5(3).

doi: 10.4172/2329-6771.1000173

21. Szymanski KM, Wei JT, Dunn RL, Sanda MG. Development and validation of an abbreviated version of the expanded prostate cancer index composite instrument for measuring health-related quality of life among prostate cancer survivors. *Urology*. 2010;76(5):1245-1250.

    doi: 10.1016/j.urology.2010.01.027

22. Rosen RC, Cappelleri JC, Smith MD, Lipsky J, Peña BM. Development and evaluation of an abridged, 5-item version of the International Index of Erectile Function (IIEF-5) as a diagnostic tool for erectile dysfunction. *Int J Impot Res*. 1999;11(6):319-326.

    doi: 10.1038/sj.ijir.3900472

23. Katz AJ, Kang J. Quality of Life and Toxicity after SBRT for Organ-Confined Prostate Cancer, a 7-Year Study. *Front Oncol*. 2014;4:301.

    doi: 10.3389/fonc.2014.00301

24. Morris BA, Holmes EE, Anger NJ, *et al.* Toxicity and patient-reported quality-of-life outcomes after prostate stereotactic body radiation therapy with focal boost to magnetic resonance imaging-identified prostate cancer lesions: results of a phase 2 trial. *Int J Radiat Oncol Biol Phys*. 2023;117(3):613-623.

    doi: 10.1016/j.ijrobp.2023.05.004

25. McDonald AM, Baker CB, Shekar K, *et al.* Reduced Radiation Tolerance of Penile Structures Associated With Dose-escalated Hypofractionated Prostate Radiotherapy. *Urology*. 2014;84(6):1383-1388.

    doi: 10.1016/j.urology.2014.07.060

26. Selek U, Cheung R, Lii M, *et al.* Erectile dysfunction and radiation dose to penile base structures: a lack of correlation. *Int J Radiat Oncol Biol Phys.* 2004;59(4):1039-1046.

    doi: 10.1016/j.ijrobp.2003.12.028

27. van der Wielen GJ, Hoogeman MS, Dohle GR, van Putten WL, Incrocci L. Dose-volume parameters of the corpora cavernosa do not correlate with erectile dysfunction after external beam radiotherapy for prostate cancer: results from a dose-escalation trial. *Int J Radiat Oncol Biol Phys*. 2008;71(3):795-800.

    doi: 10.1016/j.ijrobp.2007.10.052

28. Mangar SA, Sydes MR, Tucker HL, *et al.* Evaluating the relationship between erectile dysfunction and dose received by the penile bulb: using data from a randomised controlled trial of conformal radiotherapy in prostate cancer (MRC RT01, ISRCTN47772397). *Radiother Oncol.* 2006;80(3):355-362.

    doi: 10.1016/j.radonc.2006.07.037

29. Rasmusson E, Gunnlaugsson A, Wieslander E, *et al.* Erectile Dysfunction and Absorbed Dose to Penile Base Structures in a Randomized Trial Comparing Ultrahypofractionated and Conventionally Fractionated Radiation Therapy for Prostate Cancer. *Int J Radiat Oncol Biol Phys*. 2020;107(1):143-151.

    doi: 10.1016/j.ijrobp.2020.01.022

30. Thor M, Olsson CE, Oh JH, *et al.* Radiation Dose to the Penile Structures and Patient-Reported Sexual Dysfunction in Long-Term Prostate Cancer Survivors. *J Sex Med*. 2015;12(12):2388-2397.

    doi: 10.1111/jsm.13031

31. Obayomi-Davies O, Chen LN, Bhagat A, *et al.* Potency preservation following stereotactic body radiation therapy for prostate cancer. *Radiat Oncol*. 2013;8(1):256..

    doi: 10.1186/1748-717X-8-256

32. Achard V, Zilli T, Lamanna G, *et al.* Urethra-Sparing Prostate Cancer Stereotactic Body Radiation Therapy: Sexual Function and Radiation Dose to the Penile Bulb, the Crura, and the Internal Pudendal Arteries From a Randomized Phase 2 Trial. *Int J Radiat Oncol Biol Phys*. 2024;119(4):1137-1146.

    doi: 10.1016/j.ijrobp.2023.12.037

33. Hwang ME, Mayeda M, Shaish H, *et al.* Dosimetric feasibility of neurovascular bundle-sparing stereotactic body radiotherapy with periprostatic hydrogel spacer for localized prostate cancer to preserve erectile function. *Br J Radiol.* 2021;94(1119):20200433.

    doi: 10.1259/bjr.20200433

34. Teunissen FR, van der Voort van Zyp JRN, Verkooijen HM, Wortel RC. Neurovascular-Sparing MR-Guided Adaptive Radiotherapy in Prostate Cancer; Defining the Potential Population for Erectile Function-Sparing Treatment. *J Sex Med*. 2022;19(7):1196-1200.

    doi: 10.1016/j.jsxm.2022.04.006

35. Teunissen FR, Wortel RC, Hes J, *et al.* Adaptive magnetic resonance-guided neurovascular-sparing radiotherapy for preservation of erectile function in prostate cancer patients. *Phys Imaging Radiat Oncol*. 2021;20:5-10.

    doi: 10.1016/j.phro.2021.09.002

36. Donovan KA, Gonzalez BD, Nelson AM, Fishman MN, Zachariah B, Jacobsen PB. Effect of androgen deprivation therapy on sexual function and bother in men with prostate cancer: A controlled comparison. *Psycho-Oncol*. 2018;27(1):316-324.

    doi: 10.1002/pon.4463

37. Saxby H, Boussios S, Mikropoulos C. Androgen Receptor Gene Pathway Upregulation and Radiation Resistance in Oligometastatic Prostate Cancer. *Int J Mol Sci*. 2022;23(9):4786.

    doi: 10.3390/ijms23094786

38. van As N, Griffin C, Tree A, *et al.* Phase 3 Trial of Stereotactic Body Radiotherapy in Localized Prostate Cancer. *N Engl J Med*. 2024;391(15):1413-1425.

doi: 10.1056/NEJMoa2403365

39. van As N, Yasar B, Griffin C, *et al.* Radical Prostatectomy Versus Stereotactic Radiotherapy for Clinically Localised Prostate Cancer: Results of the PACE-A Randomised Trial. *Eur Urol*. 2024;86(6):566-576.

doi: 10.1016/j.eururo.2024.08.030

40. Poon DMC, Wong K, Lam D, *et al.* Acute Toxicity and Quality of Life With Stereotactic Body Radiation Therapy Versus Conventional Fractionated Intensity Modulated Radiation Therapy to the Prostate and Pelvis in High-Risk Prostate Cancer: A Randomized Phase 2 Trial. *Int J Radiat Oncol Biol Phys*. 2026.

doi: 10.1016/j.ijrobp.2026.06.3080

41. Martinez C, Cury F, Duclos M, *et al.* Cumulative incidence of toxicity between 2 and 5 years following SBRT to the prostate and pelvis nodes in patients with high-risk prostate cancer. *Pract Radiat Oncol*. 2026.

doi: 10.1016/j.prro.2026.06.015