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Nerve sparing can preserve orgasmic function in most men after robotic-assisted laparoscopic radical prostatectomy

Ashutosh Tewari, Sonal Grover, Prasanna Sooriakumaran, Abhishek Srivastava, Sandhya Rao, Amit Gupta, Robert Gray, Robert Leung and Darius A. Paduch

Department of Urology, Weill Medical College of Cornell University, New York Presbyterian Hospital, New York, NY, USA

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What's known on the subject? and What does the study add?
Orgasm has a major influence on patients' satisfaction with the overall sexual experience, and alternations in orgasm are associated with significant reductions in emotional and physical satisfaction, which in turn may lead to sexual avoidance behaviour, disharmonious relationships and relationship breakdowns. Studies have found a reduction in orgasmic function after retropublic radical prostatectomy. While open radical prostatectomy inevitably damages some pelvic neuronal circuitry, which will thus impact on orgasmic responses, there is a paucity of data investigating the effect on robotic assisted radical prostatectomy on this.

To our knowledge this study represents the largest analysis of orgasmic function in the robotic prostatectomy literature, and therefore would be of value to surgeons in counseling candidates for RALP about orgasmic outcomes. In our series, young men (age ≤60 years) and those who underwent bilateral nerve sparing approaches had a better recovery of their premorbid orgasmic function when compared to older men or men with no nerve sparing.

OBJECTIVE

- To investigate orgasmic outcomes in patients undergoing robotic-assisted laparoscopic radical prostatectomy (RALP) and the effects of age and nerve sparing on these outcomes.

PATIENTS AND METHODS

- Between January 2005 and June 2007, 708 patients underwent RALP at our institution.
- We analysed postoperative potency and orgasmic outcomes in the 408 men, of the 708, who were potent, able to achieve orgasm preoperatively and available for follow-up.

RESULTS

- Of men aged ≤60 years, 88.4% (198/224) were able to achieve orgasm postoperatively in comparison to 82.6% (152/184%) of older men ($P < 0.001$).
- Of patients who received bilateral nerve sparing (BNS) during surgery, 273/301 (90.7%) were able to achieve orgasm postoperatively compared with 46/56 (82.1%) patients who received unilateral nerve sparing and 31/51 (60.8%) men who received non-nerve-sparing surgery ($P < 0.001$).
- In men ≤60 years who also underwent BNS, decreased sensation of orgasm was present in 3.2% of men, and postoperative orgasmic rates were significantly better than men ≤60 years who underwent unilateral or no nerve sparing (92.9% vs 83.3% vs 65.4%, respectively; $P < 0.001$).
- Potency rates were also significantly higher in men ≤60 years and in those who underwent BNS.

CONCLUSIONS

- Age and nerve sparing influence recovery of orgasm and erectile function after RALP.
- Men ≤60 years old and those who undergo BNS are most likely to maintain normal sexual function.

KEYWORDS

cancer, robotic, prostatectomy, orgasmic, potency, outcomes, nerve sparing

INTRODUCTION

Prostate cancer is the commonest non-dermatological cancer affecting men in the Western world [1]. In the current PSA era there has been a demographic shift towards earlier detection of organ-confined prostate cancer at a younger age [2]. Radical prostatectomy (RP) remains the most common treatment for localized prostate cancer [3]. Although various surgical modifications and approaches, including nerve-sparing techniques, are currently available [4,5], sexual dysfunction (erectile and orgasmic) still continues to be a significant functional complication for many patients [6,7]. Most of the contemporary literature on sexual health outcomes after RP has been focused on erectile dysfunction rather than orgasmic responses.

Orgasm is associated with a series of regular sphincteric contractions of the bulbocavernosus muscle with an abrupt onset and termination [8]. While subjective perception of orgasm is associated with the contraction of the bulbocavernosus muscle, and orgasm typically occurs with ejaculation, neurophysiologically, orgasm and ejaculation are regulated by different neurotransmitters. Ejaculation is not necessary for orgasm as is evident in men who have undergone prostatectomy but who have normal orgasm [9]. What is known is that orgasm is mediated by complex interactions between autonomic and somatic nervous systems in conjunction with spinal cord circuits and higher brain centres [10] (Fig. 1). Arousal, defined as a progressive increase in the sensation of pleasure, results in progressive changes in neurotransmitters. Once the threshold level for orgasm is achieved an intense sensation of pleasure follows. The main regions involved in the feeling of reward that forms the subjective orgasmic response are the cortex, subparafascicular thalamic nucleus, amygdala and nucleus accumbens); the other regions illustrated in Fig. 1 are responsible mostly for the physical event of ejaculation. The pelvic (inferior hypogastric) plexus and pudendal and hypogastric nerves relay the afferent and efferent information during orgasm [10]. Normal integration of tactile, olfactory, visual and auditory sexual cues during arousal is necessary for orgasm to occur, but it is unclear to what extent the afferent signalling from the pelvic muscles and open nerve endings on the penis contribute to progression of arousal and orgasm. The fact that some men can achieve orgasm without tactile stimulation to the genital region (through auditory or visual cues) clearly indicates that orgasm is at least partly central and not a purely peripheral event.

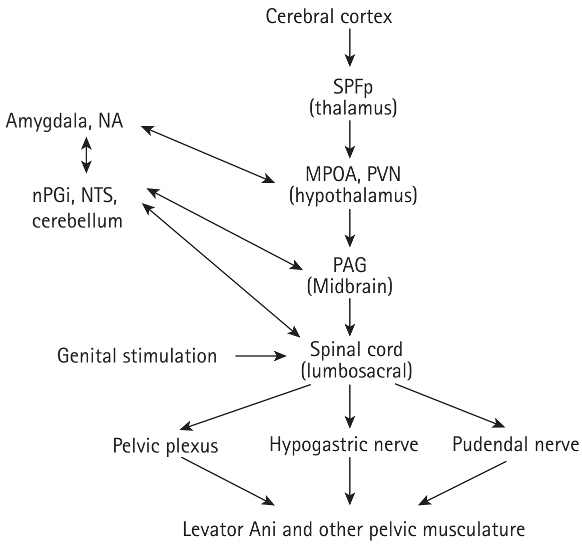


FIG. 1.
Neuronal pathway for orgasm. MPOA, medical preoptic area; NA, nucleus accumbens; nPGi, nucleus paragigantocellularis; NTS, nucleus tractus solitarii; PAG, periaqueductal gray; PVN, paraventricular nucleus of the hypothalamus; SPFp, subparafascicular nucleus of the thalamus.

Orgasm has a major influence on patients' satisfaction with the overall sexual experience [11], and alterations in orgasm are associated with significant reductions in emotional and physical satisfaction, which in turn may lead to sexual-avoidance behaviour, disharmonious relationships and relationship breakdowns [12]. One notable study investigated orgasmic function after retropubic RP and showed that only 22% of patients reported no change in their premorbid state [13]. Although open RP inevitably damages some pelvic neuronal circuitry, which will impact on orgasmic responses, there is a paucity of data investigating the effect of robotic-assisted laparoscopic radical prostatectomy (RALP) on this. Hence, we investigated the effect of RALP on orgasmic function.

PATIENTS AND METHODS

Between January 2005 and June 2007, 708 patients underwent RALP at our institution by a single surgeon (AT). Patients who were both potent (International Index of Erectile Function ≥60) and able to achieve orgasm preoperatively were eligible for this study. Orgasmic function was defined preoperatively using a physician-reported binary scale (yes/no on direct questioning of the patient). In all, 444 patients fulfilled our eligibility criteria and gave informed consent, of whom 36 patients were lost to follow-up; as a result, the final study cohort consisted of 408 patients. We analysed orgasmic and erectile outcomes in these patients as part of our Institutional Review Board-approved quality of life study. During evaluation in the clinical office before surgery, patients provided demographic information and completed self-administered standardized health-related quality of life (HRQOL) questionnaires, including the Expanded Prostate Cancer Index Composite (EPIC), and the International Index of Erectile Function. Outcomes questionnaires containing items from the sexual function domain of the EPIC HRQOL were dispatched to patients via postal or electronic mail at regular intervals after their surgery. Specifically, subjects were asked to evaluate their postoperative orgasmic function into one of five categories: normal, diminished, absent, better, or early. They were also asked to comment on whether orgasm was painful and their level of satisfaction with their orgasmic function. Subjects who did not respond to the questionnaire were then contacted via telephone by a member of the research team to ensure receipt of the questionnaire. Patients were considered potent when they achieved erections sufficient for vaginal intercourse. Additional data regarding satisfaction and pain during orgasm, as well as use of phosphodiesterase type 5 inhibitors (PDE5i) were obtained. Data collection and follow-up correspondence were performed in compliance with the Health Insurance Portability and Accountability Act.

The detailed preoperative clinicopathological characteristics of the cohort are shown in Table 1. Mean follow-up was 36 months in our cohort (median 35 months; range 24–53 months). We further stratified our cohort based on age and nerve sparing (Fig. 2). We also compared orgasmic outcomes in men who were potent and those who were impotent after surgery. Apart from the data obtained from the follow-up questionnaire, preoperative clinical data such as PSA, clinical stage and biopsy Gleason score were abstracted from medical records. Intraoperative notes were reviewed to obtain nerve-sparing data. The returned responses

TABLE 1 Preoperative variables, baseline demographics, biopsy and pathologic data of the cohort

Variable	Number of patients (N = 408)
Age, median (IQR)	60 (55,65)
60 years or less, *n* (%)	224 (54.9)
More than 60 years, *n* (%)	184 (45.1)
BMI, median (IQR)	26 (24, 29)
Preoperative IIEF, median (IQR)	69 (65, 72)
Preoperative PSA, median (IQR)	5 (3.9,6.6)
Clinical stage, *n* (%)	
T1	349 (85.5)
T2	59 (14.5)
Biopsy Gleason, *n* (%)	
≤6	166 (40.7)
7 (3 + 4)	179 (43.9)
7 (4 + 3)	38 (9.3)
≥8	25 (6.1)
Prostate volume, median (IQR)	45.5 (37.3, 54.3)
Pathology Gleason, *n* (%)	
≤6	167 (40.9)
7 (3 + 4)	182 (44.6)
7 (4 + 3)	36 (8.8)
≥8	23 (5.7)
Pathology stage, *n* (%)	
T2	349 (85.5)
T3	59 (14.5)
Positive surgical margin, *n* (%)	34 (8.3)

BMI, body mass index; IIEF, International Index of Erectile Function; IQR, interquartile range; PSA, prostate-specific antigen.

TABLE 2 Postoperative sexual function outcomes with relation to age

	Age ≤60 years (N = 224), n/N (%)	Age >60 years (N = 184), n/N (%)	P value
Orgasmic outcomes			<0.001
Postoperative orgasm present	198/224 (88.4)	152/184 (82.6)	
Have same orgasm	180/224 (80.3)	147/184(80)	
Diminished orgasm	13/224(5.8)	3/184 (1.6)	
Better orgasm	4/224 (1.8)	1/184(0.5)	
Early orgasm	1/224 (0.5)	1/184 (0.5)	
Postoperative orgasm absent	26/224 (11.6)	32/184 (17.4)	
Potency outcomes			<0.001
Postoperative potent	190/224 (84.8)	142/184 (77.1)	
Postoperative potent with bilateral nerve sparing	152/168 (90.5)	109/133 (82)	

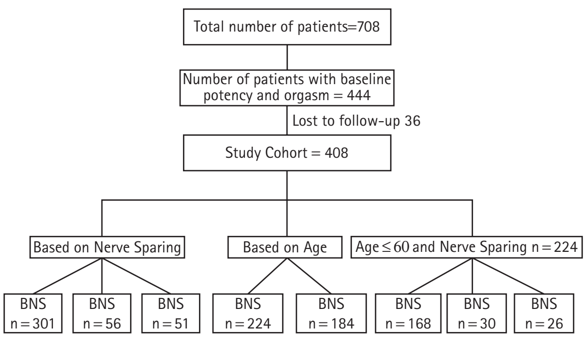


FIG. 2. Characteristics of the study cohort. BNS, bilateral nerve sparing; UNS, unilateral nerve sparing; NNS, non-nerve sparing.

to the outcomes questionnaires, along with the patients' preoperative, operative and postoperative clinicopathological data were prospectively entered into an Institutional Review Board-approved password-protected MICROSOFT® ACCESS database.

Statistical analysis was performed using PASW v18.0 (SPSS Inc., Chicago, IL, USA), with statistical significance considered at $P < 0.05$. Chi-squared test was used to evaluate the impact of age and nerve sparing on orgasmic function and potency after RALP.

RESULTS

In all, 198/224 (88.4%) men aged ≤60 years and 152/184 (82.6%) aged >60 years were able to achieve orgasm postoperatively. Postoperatively, potency was present in 190/224 (84.8%) men aged ≤60 years and in 142/184 (77.1%) men aged >60 years. Postoperative sexual function outcomes, for both orgasm and potency, were significantly ($P < 0.001$) better in men ≤60 years compared with older men (Table 2).

Postoperatively, 273 (90.7%) men with bilateral nerve sparing, 46 (82.1%) men with unilateral nerve sparing and 31 (60.8%) men with no nerve sparing were able to achieve orgasm ($P < 0.001$). Postoperative potency rates were also significantly higher in men with bilateral nerve sparing (86.7%) when compared with the unilateral nerve-sparing (71.4%) and non-nerve-sparing (60.8%) groups ($P < 0.001$) (Table 3).

In men ≤60 years of age, a significantly higher percentage of patients who underwent bilateral nerve sparing had orgasm postoperatively (92.9% vs 83.3% vs 65.4%, $P < 0.001$) and regained potency (90.5% vs 73.3% vs 61.5%; $P < 0.001$) when compared with patients who had unilateral nerve-sparing and non-nerve-sparing surgery, respectively (Table 4, Fig. 3).

Of the men who had postoperative potency, most had orgasm as well (79.5% of those <60 years; 83.1% of those who underwent bilateral nerve sparing, and 84.5% of those <60 years who also underwent bilateral nerve sparing). However, the rates of orgasm were much lower in men who were not potent after surgery (5.4% of those <60 years; 3.7% of those who underwent bilateral nerve sparing, and 6.0% of those <60 years who also underwent bilateral nerve sparing); these differences in orgasmic function were statistically significant between potent and impotent men.

From our questionnaire, we also calculated satisfaction rates (using a rating of very low, low, moderate, high, or very high) and pain associated with orgasm in patients with age ≤60 years and bilateral nerve sparing. Out of 156 patients who had postoperative orgasm, 82% had high or very high, 10.2% had moderate, 7.1% had very low or low satisfaction rates associated with orgasm. Only 3.2% (5/156) of patients complained of pain associated with orgasm. Use of PDE5i did not affect return of orgasmic function with similar usage rates in those with and without orgasm (61% vs 65%, respectively).

TABLE 3 Postoperative sexual function outcomes with relation to nerve sparing

	BNS (*N* = 301), *n*/*N* (%)	UNS (*N* = 56), *n*/*N* (%)	NNS* (*N* = 51), *n*/*N* (%)	*P* value
Orgasmic outcomes				<0.001
Postoperative orgasm present	273/301 (90.7)	46/56 (82.1)	31/51 (60.8)	
Have same orgasm	257/301 (85.4)	42/56 (75)	28/51 (54.9)	
Diminished orgasm	12/301 (4)	2/56 (3.5)	2/51 (3.9)	
Better orgasm	3/301 (1)	1/56 (1.8)	1/51 (2)	
Early orgasm	1/301 (0.3)	1/56 (1.8)	0	
Postoperative orgasm absent	28/301 (9.3)	10/56 (17.9)	20/51 (39.2)	
Potency outcomes				<0.001
Postoperative potent	261/301 (86.7)	40/56 (71.4)	31/51 (60.8)	
Postoperative potent if age ≤60 years	152/168 (90.5)	22/30 (73.3)	16/26 (61.5)	

BNS, bilateral nerve sparing; UNS, unilateral nerve sparing; NNS, non-nerve sparing.
**Includes patients with incremental nerve sparing and nerve reconstruction.*

TABLE 4 Postoperative sexual function outcomes in patients age ≤60 years and nerve sparing

	BNS (*N* = 168), *n*/*N* (%)	UNS (*N* = 30), *n*/*N* (%)	NNS* (*N* = 26), *n*/*N* (%)	*P* value
Orgasmic outcomes				<0.001
Postoperative orgasm present	156/168 (92.9)	25/30 (83.3)	17/26 (65.4)	
Have same orgasm	144/168 (85.7)	22/30 (73.3)	14/26 (53.8)	
Diminished orgasm	9/168 (5.4)	2/30(6.7)	2/26 (7.7)	
Better orgasm	2/168 (1.2)	1/30 (3.3)	1/26 (3.9)	
Early orgasm	1/168(0.6)	0	0	
Postoperative orgasm absent	12/168 (7.1)	5/30 (6.7)	9/26 (34.6)	
Potency outcomes				<0.001
Postoperative potent	152/168 (90.5)	22/30 (73.3)	16/26 (61.5)	

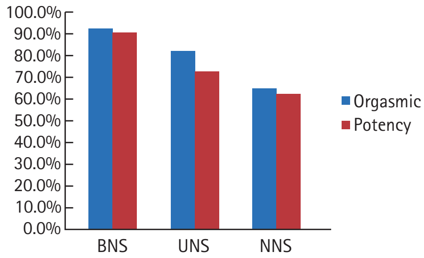
BNS, bilateral nerve sparing; UNS, unilateral nerve sparing; NNS, non-nerve sparing.
**Includes patients with incremental nerve sparing and nerve reconstruction.*

DISCUSSION

Orgasm is a compelling, brief event that is an integration of cognitive, emotional, somatic, visceral and neural processes [14]. It is a combination of physiological and psychological changes that occur coincident with ejaculation in men. Physiological changes during orgasm are tachycardia, sweating, muscle contraction and rhythmic contraction of the ejaculatory apparatus [15], whereas psychological changes include an altered state of consciousness, release of tension and emotional euphoria. As the ejaculatory apparatus (prostate, seminal vesicles and ejaculatory ducts) is removed at RP, the patients subsequently cannot emit sperm and so have 'dry ejaculations' [16]. Other changes in orgasm such as decreased intensity, anorgasmia and dysorgasmia have also been reported in patients after RP [16–18]. The consistency, quality and satisfaction of orgasm can significantly affect quality of life [16,17,19]. Therefore, any alteration in orgasm, especially its absence, is associated with significant reductions in emotional and physical satisfaction, which may in turn lead to avoidance of sexual activity and disharmony in intimate relationships [12].

Although ejaculation is coincident with orgasm in many men, the subjective sensation of orgasm can occur without ejaculation. The pelvic plexus, pudendal nerve and hypogastric nerve are involved in both sensory and motor innervations of orgasm, such that orgasm is mediated by the sympathetic, parasympathetic and somatic nervous systems. The pelvic plexus lies within a fibro-fatty plate that is flat, rectangular, sub-peritoneal, sagittal and symmetrical. It arises at the level of the intersection between the vas deferens and the terminal pelvic ureter and follows the postero-lateral aspect and circumvolutions of the seminal vesicle, with which there is a plane of surgical cleavage [20]. Our technique of posterior neural preservation in which we take great care to preserve the pelvic plexus plus its downstream fibres that form the proximal neurovascular plate, predominant neurovascular bundle, and accessory distal neural pathways [21] may therefore be responsible for our improved postoperative orgasmic rates with nerve sparing compared with non-nerve sparing. It may also be possible that some men have more damage to the bulbocavernosus muscle and the distal fibres of the pudendal nerve during non-nerve sparing as a result of more aggressive dissection generally,

FIG. 3. Postoperative potency and orgasmic outcomes in patients with age ≤60 years, in relation to nerve sparing. BNS, bilateral nerve sparing; UNS, unilateral nerve sparing; NNS, non-nerve sparing.



accounting for the lack of orgasm. In our series, young men (age ≤60 years) had improved postoperative orgasmic function when compared with older men. Earlier series have also reported age-dependent responses, where younger patients did well postoperatively both in terms of orgasm and erectile function [18]. Hypogonadism and penile hyposensitivity also increase with age and this may also account for why orgasm is diminished in older patients. Hollenbeck *et al.* [22] used the EPIC validated questionnaire to study a cohort of 671 patients undergoing open RP. They reported that nerve-sparing technique, patient age, prostate size, time since prostatectomy, income and education level were significant independent predictors of sexual health outcomes after prostatectomy. Patients below 58 years of age were able to achieve orgasm in 84%, 68% and 67% after bilateral, unilateral and non-nerve-sparing surgery respectively compared with patients with aged over 69 years who achieved orgasm in 58%, 58% and 30%, respectively.

Van der Aa *et al.* [23] studied the effect of unilateral nerve-sparing surgery on orgasm and reported that 84.8% of men had the ability to achieve orgasm postoperatively whereas erectile function recovery was 45% for partial erections and 30% for complete recovery at 18 months. In our series we found that 90.7% and 82.1% of men were able to achieve orgasm with bilateral and unilateral nerve sparing, respectively, after a follow-up of at least 12 months. Noldus *et al.* [24] found that 29% of men with unilateral nerve sparing and 52% men with bilateral nerve sparing were potent postoperatively. Further, about 80% of men had unchanged, 9% had improved and 11% had decreased experience of orgasmic function irrespective of whether they were potent or not. Our own results, however, seem to suggest that orgasmic function is closely allied to potency. Men who were potent postoperatively were far more likely to preserve orgasm than those who were not. It may be therefore that nerve sparing improves orgasm by its confounding effect on potency.

The cause of dysorgasmia is not well understood. It is postulated that the physiological bladder neck closure that occurs during orgasm in men after an RP translates into spasm of the vesico-urethral anastomosis or pelvic floor musculature dystonia [25]. In this study we found that dysorgasmia was present in 3% patients aged ≤60 who underwent bilateral nerve sparing and had a follow-up of at least 12 months. Similar results have been shown in previous studies. Barnas *et al.* [13] in their retrospective study found that 14% of the patients had dysorgasmia. In these men 33% experienced pain always (i.e. with every orgasm), frequently in 13%, occasionally in 35% and rarely in 19%. Most patients (55%) had orgasm-associated pain of less than 1-min duration.

In this study we did not find any significant improvement in orgasmic function with the use of PDE5i. The literature regarding the effect of PDE5i on orgasmic function after RP is scarce, although one group confirmed our findings [26].

This study has a number of limitations. We did not assess orgasm-associated urine leakage (climacturia) in these patients, and this would be a useful parameter to measure because there is good evidence that this impacts on sexual satisfaction levels [27]. Other orgasm-related symptoms were also not evaluated: orgasmic headaches, epileptiform aura or migraines triggered by orgasm and male multiple orgasms. However, all of these are rare and so unlikely to have significantly confounded our findings. Also, our assessment of orgasm was purely subjective and defined by the patient; we made no attempt to validate the accuracy of reporting normal, diminished, improved, early, absent, or painful orgasm using a neurophysiological approach. Investigators have shown that serum prolactin levels increase for over 1 hour after orgasm [28]. However, the subjective feeling of orgasm is what is most important for the patient so this is not a major limitation. Although we investigated the use of PDE5i and whether patients were able to orgasm or not, we did not record the use of other neuropharmacological agents that have been shown to affect climactic sensation: selective serotonin reuptake inhibitors, antidepressants, opiates, anticonvulsants and antipsychotics [29–32].

Another limitation is that we did not assess the psychological factors that could impact on orgasmic outcomes in our patients, and we did not ask patients whether they had sought counselling or other more intensive psychological therapies, all of which may confound our findings. Third, we did not look at earlier follow-up time-points so cannot comment on the effects of surgery on orgasmic function in the first postoperative year. Fourth, although our preoperative measure of erectile function used a validated assessment tool, the International Index of Erectile Function, our postoperative follow-up measure of potency was based on a single question: the ability or not to have an erection sufficient for penetrative vaginal intercourse. Of course this is likely to introduce bias in our results because there is evidence that this single-question approach is not as accurate as the validated International Index of Erectile Function [33–34]. However, we were consistent in our use of our assessment tools such that any differences we found between groups are still valid. Nevertheless, we cannot exclude the possibility that improved potency above and beyond the definition applied in the young and bilateral nerve-sparing groups confounded our improved orgasmic results. Also, while we found that men who were able to have vaginal intercourse (our definition of postoperative potency) were more likely to preserve orgasm, we did not measure potency or orgasmic function on a quantitative scale, and so cannot comment on whether highly potent men had improved orgasmic function compared with men who were only just able to sustain an erection hard enough for penetration. As potency function might be a confounding factor for orgasmic function, we are currently performing a prospective study looking at this issue. Finally, our follow-up period ranged from 24 to 53 months so there is the possibility that time itself might have confounded our results. However, most functional outcomes have stabilized by 1 year postoperatively so this is unlikely to have changed the findings significantly. Despite these limitations in our dataset, to our knowledge this study represents the largest analysis of orgasmic function in the robotic prostatectomy literature, and we feel it would be of value to surgeons when counselling candidates for RALP about orgasmic outcomes.

Orgasmic dysfunction is a common complication associated with radical prostatectomy. It can take the form of decreased intensity, absence or dysorgasmia. Younger men and those who undergo bilateral nerve-sparing approaches are most likely to recover their premorbid orgasmic function.

CONFLICT OF INTEREST

Dr Ashutosh Tewari has received research grants from the Intuitive Surgical and the Prostate Cancer Foundation; he is also the endowed Ronald P. Lynch Professor of Urologic Oncology and Director of the Lefrak Center of Robotic Surgery and Prostate Cancer Institute, Weill Cornell Medical College. Dr Prasanna Sooriakumaran is the ACMI Corp. Endourological Society Corporate Fellow and also receives financial sponsorship from Prostate UK.

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Correspondence: Ashutosh K. Tewari, Department of Urology, Weill Medical College of Cornell University, 525 East 68th Street, Starr 900, New York, NY 10065, USA.
e-mail: ashtewarimd@gmail.com

Abbreviations: **RP**, radical prostatectomy; **PDE5i**, phosphodiesterase type 5 inhibitor.