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^{103}Pd brachytherapy versus radical prostatectomy in patients with clinically localized prostate cancer: A 12-year experience from a single group practice

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ABSTRACT

PURPOSE: In an effort to shed light on the continuing debate over the best treatment options for patients with localized prostate cancer, we present a retrospective review of patients from a single group community urology practice.

METHODS AND MATERIALS: Data from 1707 patients were reviewed. These patients, with T1 or T2 adenocarcinoma of the prostate, were treated from 1992 to 2004 with either brachytherapy or radical retropubic prostatectomy (RRPP); 81% were aged over 65 years. Patients were classified into risk groups based on initial prostate-specific antigen (PSA) and Gleason score. Time to PSA-indicated recurrence was used as the measure of disease control and cure.

RESULTS: Time to PSA-indicated recurrence was used as a measure of efficacy. Brachytherapy with ^{103}Pd exclusively and RRPP were found to provide equivalent control ($<$0.4 ng/mL for prostatectomy and $<$3 successive rises in PSA as defined by the American Society for Therapeutic Radiology and Oncology [ASTRO]) in low-risk groups (89% seeds vs. 94% RRPP). In intermediate (89% seeds vs. 58% RRPP) and high-risk (88% seeds vs. 43% RRPP) groups, brachytherapy patients had better control rates. The addition of external radiation, with or without luteinizing hormone-releasing hormone therapy, improved biochemical control rates in intermediate and high-risk brachytherapy groups.

CONCLUSION: The results failed to show any superiority of prostatectomy over brachytherapy with ^{103}Pd (TheraSeed; Theragenics Corp., Buford, GA) regarding time until relapse as indicated by PSA level increase ($>$0.4 ng/mL for prostatectomy and $>$3 successive rises in PSA as defined by ASTRO). We recently reviewed our techniques and improved equipment from 1995 to present and found major gains with both brachytherapy and surgery. Low risk brachytherapy resulted in 99% freedom from PSA failure while surgery showed results of 97%. Brachytherapy and prostatectomy should be offered without bias to all men with stage T1 and T2 organ-confined prostate cancer.

Keywords: Prostate; Cancer; ^{103}Pd; Brachytherapy; Radical prostatectomy; PSA; Recurrence-free

Introduction

In 1991, we began our brachytherapy program in an effort to offer an alternative to both radical prostatectomy and external radiation therapy. Nerve-sparing surgery and conformal radiation therapy were in their infancy, and prostate-specific antigen (PSA) was beginning to make an impact in the diagnosis of early stage prostate cancer. Our group faced several challenges. First, the demographics of our patient population included a large group of active patients

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aged over 65 years, with projected excellent longevity based on family history, who required treatment. Second, comorbid medical problems found in these older patients combined with the poor results and complications of conventional external radiation therapy created a need for an alternative treatment.

Currently, there are limited published data comparing radical prostatectomy and brachytherapy in the post-PSA era and biased advice to patients occurs, as evidenced by recommendations of different specialties. For example, urologists are more likely to recommend surgery, whereas radiation oncologists recommend radiation therapy (1). A randomized study comparing these two treatment approaches would provide the most definitive evidence of their relative efficacy. The American College of Surgeons Oncology Group (ACOSOG) study to compare prospectively Brachytherapy versus Surgery closed because of inability to enroll patients. We present an analysis of outcome data for patients provided with these treatments. Because such nonrandomized treatment groups are unlikely to be equivalent with respect to prognostic factors, such an analysis needs to take this inequality into consideration. There are two ways to achieve this: (*1*) by performing analyses on subsets defined by risk factors; and (*2*) by performing multivariate analyses that study the effect of treatment while adjusting for other prognostic factors.

We report on both approaches below. In an effort to help physicians offer their patients unbiased advice on the best alternatives for treatment of localized prostate cancer, we present a retrospective comparison of the effectiveness of ^{103}Pd, brachytherapy, and radical retropubic prostatectomy (RRPP) in 1707 men with stage T1 and T2 adenocarcinoma of the prostate. We used time to PSA-indicated recurrence as the measure of efficacy.

This report reviews the effects of prostatectomy and brachytherapy in a large population treated in our clinic between 1992 and 2004. Seventy-eight percent of our patient population is aged over 65 years. For patients aged over 70 years, we often recommend brachytherapy over radical surgery, especially if there are medical comorbidities. This age distribution accounts for the preponderance of patients having implants placed by our group, rather than any lack of surgical experience in performing effective radical prostatectomies with minimal incontinence or other complications. Our group includes members trained at academic centers that are centers of excellence in RRPP.

Methods

Data from 1707 patients treated from 1992 to 2004 in our community-based private practice urology group were reviewed, and patients were classified by risk groups. Risk grouping was defined by preoperative PSA levels and Gleason scores. Of the 1380 brachytherapy patients and 327 prostatectomy patients treated since December 1992, 1177 of the brachytherapy patients and 281 of the prostatectomy patients had data sufficient for inclusion in this report. Details are given in Tables 1 and 2. These data were collected from patients' charts by our clinical research department and transmitted monthly to an independent statistician (co-author AC) for analysis.

Standard staging studies, digital rectal examination, and PSA assays were performed to confirm organ-confined disease, and ultrasonography was used to determine gland size and rule out obvious extracapsular extension. Fourteen to 18 transrectal ultrasound-guided prostate biopsies (including seminal vesicles) were performed and were individually labeled and analyzed. We have been doing this since 1992 because we felt then that prostate cancer was multifocal and we wanted to be certain of the true volume and extent of disease. We can better estimate this by knowing the percentage of cores that are positive and the percent of each core that contains tumor. Additionally, we often see patients for second opinions who have elevated PSAs and previous negative sextant biopsies. When we repeat their biopsy with our technique of increased numbers of cores, they are not uncommonly positive. This has proven to be the new standard in the urological community in the last couple of years. We do all our ultrasound-guided biopsies under sedation in our ambulatory surgery center. We also add additional seeds to the cancer areas during the implant when we know the precise location of the positive cores, which have been individually labeled.

Additionally, we were embarking on a new treatment in 1991 and wanted to be precise in the evaluation of our starting point and our treatment results. We also used these results in the early years to pick up geographic misses or cold spots (due to older ultrasound equipment and evolving technique) and re-treated these successfully in 75% of 40 earlier failures.

Most patients received bone scans, as well as CT scans of the pelvis. We are a private practice urology group, and each physician counseled his patients on the basis of his experience. The precise techniques used for seed implantation have been described previously (2, 3).

We used freedom from PSA failure as the definition that covers all forms of recurrence including biochemical recurrence. Prostate-specific antigen levels were evaluated 3 months and 6 months after surgery or seed implantation and every 6 months thereafter. In the surgery group, a PSA level greater than 0.4 ng/mL was considered a recurrence. We

Table 1
Data on brachytherapy and prostatectomy patients

	Brachytherapy n = 1177	Prostatectomy n = 281
Total patients	1380	327
Stage greater than B or unknown	31	32
Insufficient data	172*	14
Available for analysis	1177	281

* 121 with seed implant within 1 year of this analysis.

Table 2
Characteristics of patients treated with brachytherapy or prostatectomy

	Brachytherapy patients n = 1177	Prostatectomy patients n = 281
Age, years		
Mean	71.9	63.1
Range	48–93	28–80
Initial PSA, ng/mL		
<4.0	28.4 (n = 334)	34.9 (n = 98)
4.0–10.0	56.2 (n = 661)	49.5 (n = 139)
10.1–20.0	12.2 (n = 143)	12.1 (n = 34)
>20.0	3.3 (n = 39)	3.6 (n = 10)
Gleason score, %		
2–6	71.0 (n = 822)	66.8 (n = 187)
7–10	29.0 (n = 335)	33.2 (n = 93)
Risk group, %		
Low	61.6 (n = 723)	57.3 (n = 161)
Intermediate	31.6 (n = 371)	36.3 (n = 102)
High	6.7 (n = 79)	6.4 (n = 18)
Stage		
T1	27.3 (n = 321)	18.5 (n = 52)
T2	72.7 (n = 856)	81.5 (n = 229)

chose a cutpoint of 0.4 ng/mL as an indicator of recurrence, because that value has been often used by others in reports of the efficacy of prostatectomy (4). This is arbitrary, but seems to have stood the test of time. For the brachytherapy group, we used the American Society for Therapeutic Radiology and Oncology (ASTRO) definition of recurrence that is based on three consecutive increases in PSA. We recognize the definitions are often controversial, but experience and literature reviews have proven these to be the most reliable at this time. Using the ASTRO definition, the time of recurrence is taken to be the average of the time of the first increase and the time of the previous reading. In addition, as time (years) from date of the seed implant increases, the majority of our patients' PSA levels nadir to 0.0–0.5 ng/mL (84–93% respectively). Seventy-four of the prostatectomy patients had pre- or post-operative hormone therapy. About half of the patients in the brachytherapy group received luteinizing hormone-releasing hormone and antiandrogen 3 months before implant and 2 months after. This was done primarily for size reduction of the gland to less than 50 cm^3 and for patients in very high-risk groups, depending on the judgment of the primary urologist in each case. In the hopes of improving our results, we recently (last 5 years) have begun to add external radiation to the regimen for intermediate and high-risk groups, and patients with bilateral high volume disease, even if low-risk. We based this on the results of other groups showing excellent results with the combination (5).

The two treatment modalities of brachytherapy and prostatectomy were compared with respect to time to recurrence. This was defined as the time from the date of surgery or seed implantation until the date recurrence was determined (as previously defined) or the date the patient was last seen. Patients who died without having a recurrence were considered censored at the date last seen. Because all mortalities were attributed to causes unrelated to the patients' prostate cancer, we felt that this was an appropriate approach. The primary analyses comparing the treatment groups with respect to time to recurrence were by log-rank tests specific to initial risk groups as defined below. In addition, we performed Cox proportional hazards regression to explore the simultaneous effects of multiple variables, including treatment. Statistical analyses of outcomes were done using SAS (version 8.2; SAS Institute, Inc., Cary, NC). Proc Lifetest and Proc Phreg were used for analyses of time to recurrence; Proc Means and Proc Freq were used for descriptive statistics.

Classification by risk groups

Patients were classified by risk group using a standard that factors in both initial serum PSA and Gleason score. The low-risk group was defined by an initial serum PSA less than or equal to 10.0 ng/mL and a Gleason score of less than 7. The intermediate-risk group showed an initial PSA level greater than 10.0 ng/mL or a Gleason score greater than or equal to 7, but not both concurrently. Finally, the high-risk group had an initial PSA level greater than 10.0 ng/mL and a Gleason score greater than or equal to 7. Although clinical stage is an important prognostic indicator of outcome after both radiation and prostatectomy, we chose this risk classification system for this review of our group's practice in the treatment of prostate cancer.

Patients

Our 12-year review of 1707 charts yielded 1458 patients with sufficient data for inclusion in this report. Of the 1458 patients, 1177 were treated with brachytherapy and 281 with prostatectomy. Patients who had prostatectomies were somewhat younger and at slightly higher risk than those who received brachytherapy; otherwise, demographic characteristics in the two groups were similar (Tables 1 and 2). Mean preoperative PSA levels in the brachytherapy group were 7.0 ng/mL (range, 0.0–93 ng/mL) and 6.5 ng/mL (range, 0.0–61 ng/mL) in the prostatectomy group.

Treatment decisions were made over several weekly visits with patients and spouses. Factors contributing to these decisions included careful review of patient's age and life expectancy, sexual potency, bladder outlet obstructive symptoms, risk category (determined by initial PSA level and Gleason score), review of CT scan of pelvis, bone scan, and risks and complications of both potential treatments. Younger patients (aged less than 70 years) were fully informed that surgery could not be easily undertaken after brachytherapy (if it failed as a primary treatment) without significant increase in complications of incontinence, impotence, and possible rectal injury.

All details of both procedures and their risks of recurrence and complications were repeated at each visit, and patient input and choices were encouraged. We emphasized that

failures in both groups would be handled with hormone therapies, and that radiation therapy was a possibility in the prostatectomy group. Patient preference after careful education was the deciding factor. We are currently engaged in a prospective study to evaluate pre-and post-operative patient quality of life so we may accurately compare these two treatment groups. This will enhance our ability to precisely educate our patients and definitively state our incontinence and impotence results.

Results

The results presented here fail to show any superiority of prostatectomy over brachytherapy with ^{103}Pd (TheraSeed; Theragenics Corp., Buford, GA) with respect to time until relapse indicated by PSA level increase (>0.4 ng/mL for prostatectomy and the ASTRO criteria for brachytherapy of 3 consecutive increases in PSA levels) (6). In fact, any differences between treatments favor brachytherapy, particularly for intermediate and high-risk groups. Figure 1 shows Kaplan–Meier estimates of recurrence for all patients having seeds or surgery. Figures 2, 3, and 4 show Kaplan–Meier estimates of recurrence in various patient cohorts over time by risk group. Recurrence was generally equal in the low-risk groups of both surgery and seed implants with no statistically significant differences observed. Patients with intermediate and unfavorable-risk groups had better results with brachytherapy. Follow-up time was up to 11 years for the brachytherapy patients and up to 8 years for the prostatectomy patients, with a median follow-up time of 3 years for each treatment group. To further explore the impact of treatment, taking into account possible differences between the treatment groups with respect to prognostic factors, we also performed a multivariate Cox proportional hazards regression. This methodology models the log of the instantaneous hazard as a linear function of a set of independent variables. The variables treatment, initial PSA level, Gleason score, stage, and previous hormone therapy were used in the model. These results are presented in Tables 3 and 4. The most significant variable was treatment ($p = 0.0015$), with brachytherapy associated with a 56% reduction in the hazard of PSA failure. Stage was also significant ($p = 0.019$), with stage T2 patients having about three times the hazard of stage T1 patients. Initial PSA ($p = 0.019$) was also significant with each ng/mL associated with about a 3% increase in hazard. Use of hormone therapy and Gleason score were not significant at the conventional 0.05 level. When hormone therapy was initiated we used Lupron (TAP Pharmaceuticals, Lake Forest, IL) and Eulexin (Schering Plough Corp., Kenilworth, NJ), or Casodex (AstraZeneca LP, Wilmington, DE) for 3 months before the implant and 2 months after. We noted that the PSA level reached a nadir faster in the hormone group than in the non-hormone group, but over 10 years there was no difference in freedom from PSA failure.

A different serum PSA endpoint is necessary for the brachytherapy and prostatectomy groups, because no prostate tissue is left in the prostatectomy group (7). Therefore, a PSA level greater than 0.4 in the post-prostatectomy patient indicates recurrence. In the brachytherapy group, where prostate tissue remains *in situ*, a higher PSA level is expected. Following the ASTRO guidelines requires three consecutive rises as an indication of PSA failure. As we go beyond 3 to 5 years, most of our patients' PSA levels are between 0.5 and 1.0 ng/mL, indicating the slowly persistent kill effect of the radioactive seeds on the remaining prostate tissue. The 0.5 ng/mL PSA level nadir was achieved by 986 (84%) of the 1177 brachytherapy patients: 495 (34%) at 3 months, 356 (30%) at 1 year, 120 (10%) at 2 years, 61 (5%) at 3 years, 18 (2%) at 4 years, 16 (1%) at 5 years, and 10 (1%) after 5 years. This same nadir was achieved by 278 (99%) of the 281 prostatectomy patients: 266 (95%) at 3 months, 10 (4%) at 1 year, and 2 (<1%) at 2 years. The 1.0 ng/mL nadir was achieved by 1093 (93%) of the 1177

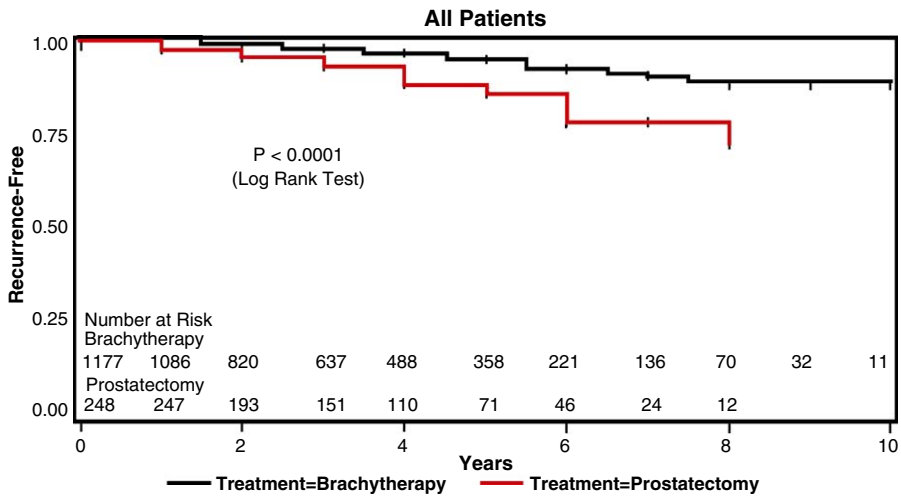

Fig. 1. Seeds (89%-ASTRO) vs. RRP-prostatectomy (72% ≤0.4) in all patients.

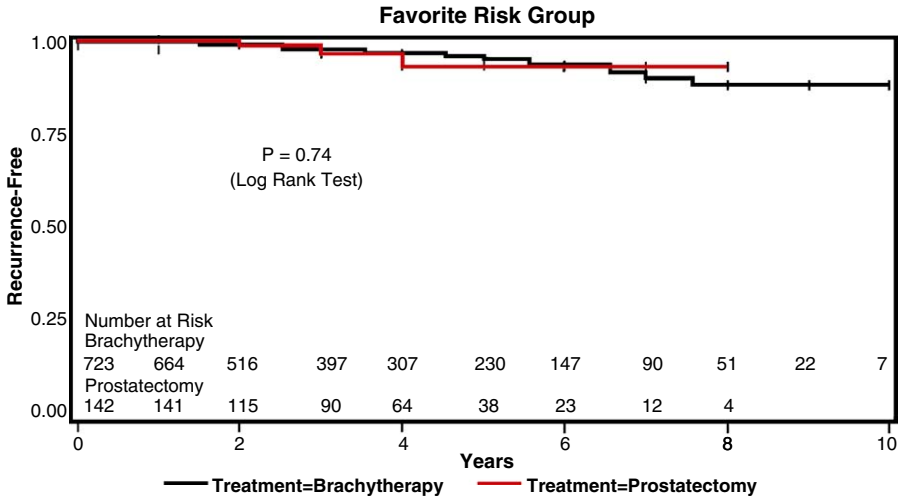

Fig. 2. Seeds (89%-ASTRO) vs. RRP-prostatectomy (94% ⩽0.4) in favorable risk group.

brachytherapy patients: 545 (46%) at 3 months, 427 (36%) at 1 year, 73 (6%) at 2 years, 32 (3%) at 3 years, and 16 (about 1%) after 3 years. For the prostatectomy patients, the 1.0 ng/mL nadir was achieved by 278 (99%) of the 281 patients: 266 (95%) at 3 months, 10 (4%) at 1 year, and 2 (<1%) at 2 years. Figures 5, 6, and 7 show Kaplan–Meier curves for recurrence over time by risk group for those 24 patients receiving combined therapy of seeds followed by external radiation therapy versus those receiving only the seeds. The benefits of the addition of radiation therapy are most apparent in the intermediate and high-risk groups. Figures 8, 9, and 10 show Kaplan–Meier curves for recurrence over time by risk group using hormone therapy (HT). HT has shown survival benefits in favorable and intermediate populations. Figure 11 shows a typical dosimetry curve done for quality control after every implant we do. Tissue volume (V) represents the amount of tissue receiving the radiation from the implant, with respect to dose (D). The prostate (red line) gets 100% of prescribed dose throughout the gland (V100); 68% of the prostate gets 150% of prescribed dose. Ninety percent of the urethra (green line) gets 100% of prescribed dose; 0.4% of the urethra gets 150% of prescribed dose.

To continue improving our dosimetry and sparing of the rectum, urethra and bladder, we use a seed activity of 2.25 U for full dose and 1.76 U for combination with radiation therapy. The evaluation of the final dose distribution is based first on a visual inspection of both the plane-by-plane isodose distribution, and the 3-D rendering of the dose cloud to insure that the gland is covered with a suitable margin (3–5 mm) around the lateral lobes, and somewhat less on the rectal side. The final evaluation is based on the dose volume histogram (DVH) with the following criteria:

1. The percentage of the gland receiving more than 150% of the prescribed dose (V150) should be between

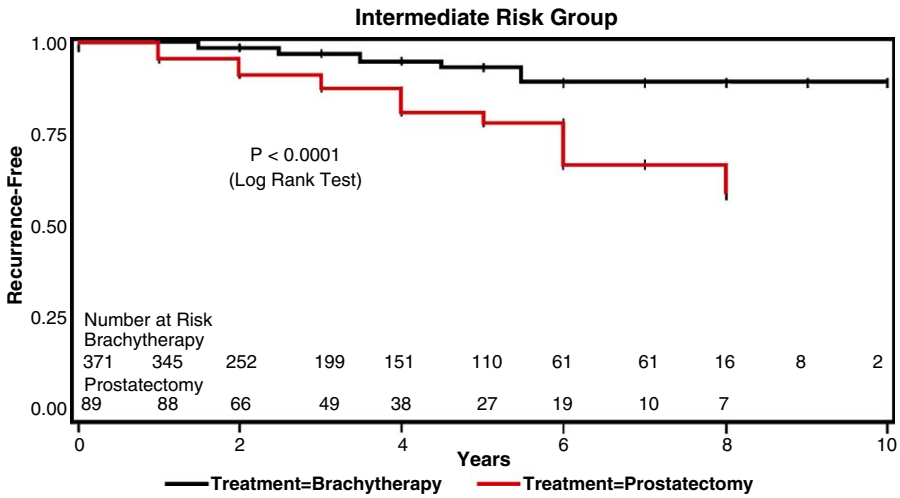

Fig. 3. Seeds (89%) vs. RRP (58%)-prostatectomy in intermediate risk group.

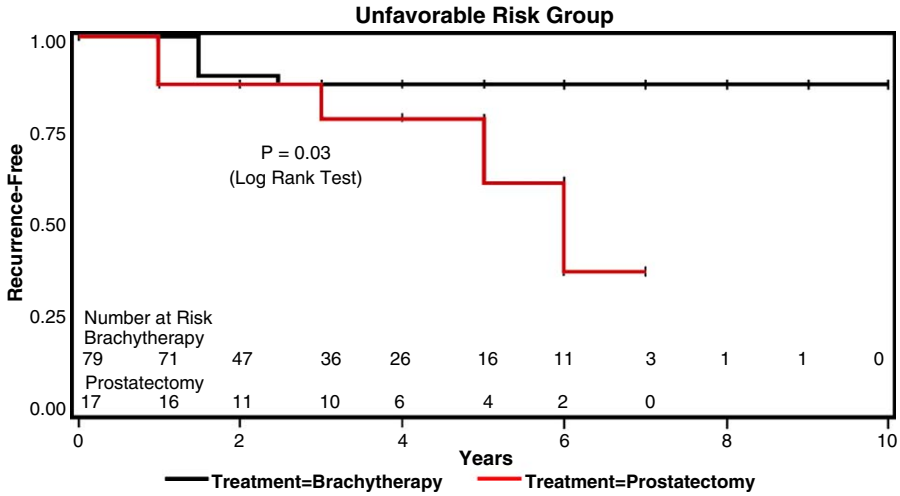

Fig. 4. Seeds (88%) vs. RRP (43%)-prostatectomy in unfavorable risk group.

60% and 70%. This high dose region should be confined mainly to the lateral lobes where the higher probability of cancer exists.
2. The V150 for the urethra and/or the transurethral resection (TUR) defect should be less than 0.5%.
3. For reseed patients, the V150 for the urethra should be less than 1%, if possible.

Discussion

Our experience challenges the assumption that radical prostatectomy has a better cure rate and should be the gold standard for treatment of localized prostate cancer (8). For the past 12 years we have been offering, without bias, either RRPP or seed implantation to patients with nonpalpable lesions discovered by elevated PSA (stage T1), or with palpable induration or nodules not reaching the seminal vesicles (stage T2). Because we perform both procedures, we are in a unique position to evaluate and compare the efficacy of these two approaches. Brachytherapy and radical prostatectomy provided similar responses to treatment (no significant differences given the sample size, length of follow-up, and numerical differences observed) for localized prostate cancers.

Our results show equal or better Kaplan–Meier curves for freedom from recurrence across all preoperative serum PSA subsets of patients treated with brachytherapy compared with patients treated with radical prostatectomy. In general, results from retrospective studies must be viewed with some reservation, because they lack the rigor and controls afforded by prospective randomized studies. Selection bias is inherent in most of these studies. Clearly, patients in our study were not selected and assigned treatment at random and data collection was controlled by what we had on file.

Other potential confounding factors include the fact that surgery and brachytherapy are not essentially comparable treatments; relapse was necessarily defined differently for the two groups. Some subgroup sample sizes were extremely low and follow-up time may be inadequate for this disease, in which recurrence often occurs many years after treatment. Since few urology practices have done brachytherapy for very long, few, if any, have extended follow-up for many

Table 3
Freedom from recurrence of prostate cancer based on initial PSA and risk group

	Brachytherapy									Prostatectomy								
	Years									Years								
	Patients N	3	4	5	6	7	8	9	10	Patients N	3	4	5	6	7	8	9	10
Total patients	1177	820	495	363	358	139	136	33	12	281	190	147	106	70	43	13	12	0
PSA, ng/mL																		
0.0–4.0	334	.98	.98	.98	.94	.91	.91	.91	.91	98	.99	.99	.99	.88	.88	.88	-	-
4.1–10.0	661	.98	.96	.94	.92	.90	.88	.88	.88	139	.91	.84	.81	.77	.77	.77	-	-
10.1–20.0	143	.93	.93	.83	.88	.88	.88	.88	.88	34	.86	.86	.75	.62	.62	.62	-	-
>20.0	39	.93	.93	.93	.93	.93	.93	.93	.93	10	.75	.60	.60	.60	.60	-	-	-
Risk group																		
Low	723	.98	.97	.96	.94	.91	.89	.89	.89	161	.97	.94	.94	.94	.94	.94	-	-
Intermediate	371	.97	.95	.93	.89	.89	.89	.89	.89	102	.88	.81	.78	.66	.66	.58	-	-
High	78	.88	.88	.88	.88	.88	.88	.88	.88	17	.80	.80	.64	.43	.43	-	-	-

Table 4
Cox regression results

Variable	Hazard ratio	95% CI	*P* Value
Treatment	.441 (brachytherapy: prostatectomy)	(0.27, 0.73)	0.0015
Initial PSA, ng/mL	1.033 (per unit increase in ng/mL)	(1.01, 1.05)	0.019
Gleason score	1.130 (per unit increase)	(0.94, 1.36)	0.196
Stage	3.031 (stage T2: stage T1)	(1.20, 7.68)	0.019

patients. Nevertheless, we feel that there is value in reporting our results thus far. Although we report the median follow-up for each treatment group to be 3 years, substantial numbers of patients have a longer period of follow-up than this. Three hundred sixty brachytherapy and 72 prostatectomy patients were followed for 5 years or more. Knowing this in advance, our rationale for performing this retrospective analysis was to test statistically what years of experience have indicated to us: that appropriately selected patients treated with brachytherapy have outcomes at least as good as those treated with surgery.

Much discussion in the literature has centered on nadir serum PSA after brachytherapy. Controversy continues over what nadir represents freedom from failure and how comparable this nadir is to radical prostatectomy data. In our hands, our definition has withstood the test of time, and, in fact, our nadir gets lower with each post-implant year (2, 3).

We feel that all patients with a 10-year life expectancy are candidates for treatment. With the increasing size of the baby boom population, a minimally invasive option is even more important. According to the National Vital Statistics Report (9), a 60-year-old has a 21.5-year life expectancy. A man reaching age 70 has a 12.8-year life expectancy, and a man reaching 80 has a 7.5-year life expectancy.

Since 1993 we have treated 1380 patients with brachytherapy and 327 with prostatectomy. Treatment selection is based on the premise that each patient should have a minimum of 10 years of life expectancy. To help choose the most appropriate treatment, we evaluate patients based on the following:

1. The stage and extent of tumor, as determined by digital rectal exam and transrectal ultrasound.
2. Prostate size and Gleason score.
3. Patient age and life expectancy (9).
4. Risk factors for postoperative complications, such as pretreatment voiding difficulty and degree of bladder outlet obstruction.

In the absence of definitive evidence that one treatment for organ-confined disease will be superior to the other, the urologist discusses options with the patient. The advantages and disadvantages of surgery and radiation therapies are explained, and the patient is informed of the operative risks. The opportunity to avoid surgery is weighed against the benefit derived from removal of the prostate gland and the cancer, and an unbiased discussion of the estimated benefits and risks for that particular patient ensues. We encourage him to think carefully and come to his own decision. Thus, the patient is able to make a well-informed choice based on his own assessment of discussions with the urologist, the radiation oncologist, and his family. Hormone therapy has had a positive effect in our hands and insignificant effects by others (10). Overall, our patients have experienced complications relatively infrequently. Our rates of incontinence with brachytherapy fall in line with literature data (5, 11) of $<1\%$ in the absence of a prior transurethral resection of the prostate, and $<5\%$ with a prior resection. The incidence of impotence over time is estimated to be 10–15% (depending on preoperative potency, when this information was available from our chart documentation). We are currently undertaking a prospective study of these complications and will publish these results when significant numbers accrue. Short-term morbidity is minimal; patients

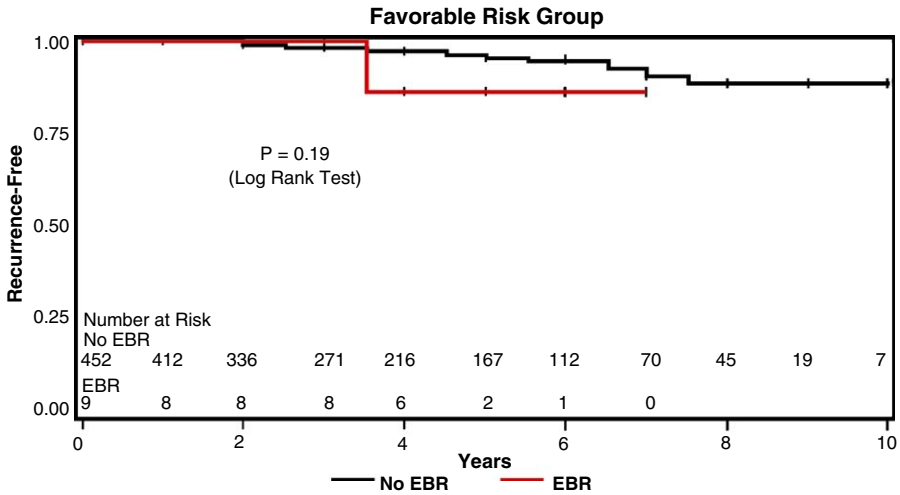

Fig. 5. Freedom from PSA recurrence (88% with RT vs. 90% no RT) in favorable risk group.

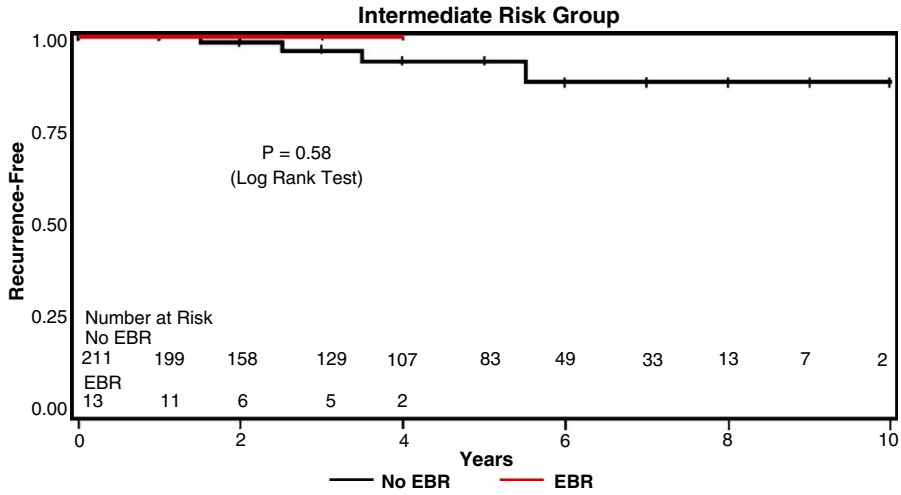

Fig. 6. Freedom from PSA recurrence (100% with RT vs. 89% no RT) in intermediate risk group.

resume full activities 2 to 3 days after a 1-hour outpatient procedure. After prostatectomy, the incidences of incontinence and impotence are less than 1% and 45%, respectively, rates that parallel those of leading centers. Despite the low number of surgery patients in this report, our safety data demonstrate sufficient experience and competence for a valid comparison of surgery and brachytherapy. The current estimates of complications come from chart reviews rather than any formal survey and are retrospective with all the inherent problems associated with reporting this type of data. The results obtained by the addition of external conformal radiation in those intermediate and high-risk patient groups are favorable. These are the patients who statistically are at greatest risk for extracapsular extension of the cancer, and therefore at highest risk of distant spread. After the date of treatment, if the disease was not fully eradicated with primary treatment, these patients would fail by distant metastasis from tumor cells left by inadequate dosage of radiation or location of seeds at the margins. Although these results are clearly short-term and therefore not statistically significant, the trend is clearly shown and we expect it to continue. The patients clearly seem to be benefiting and have not had major additional morbidity. These outcomes confirm the results from the Seattle group (5).

Conclusions

We believe that the urologist functions as the main physician for the diagnosis of patients with prostate cancer. It is therefore the urologist's burden to counsel patients about their stage and treatment options in an unbiased manner. Most

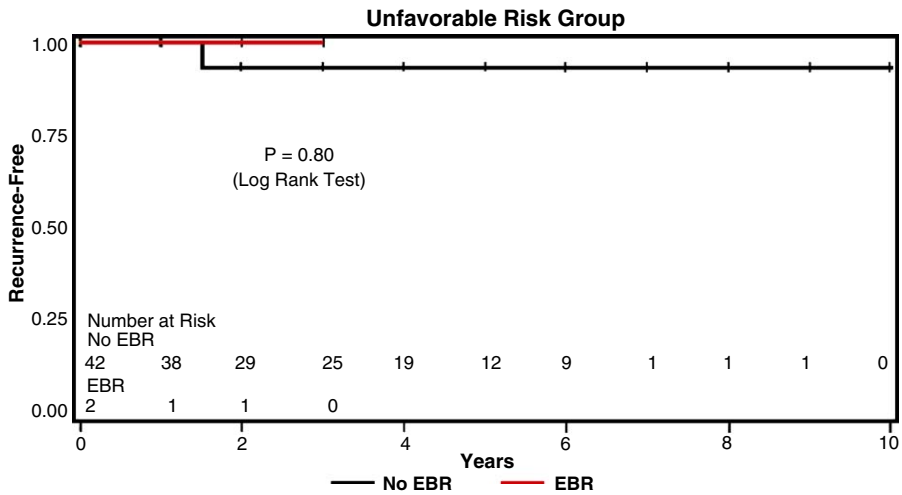

Fig. 7. Freedom from PSA recurrence (100% with RT vs. 94% no RT) in unfavorable risk group.

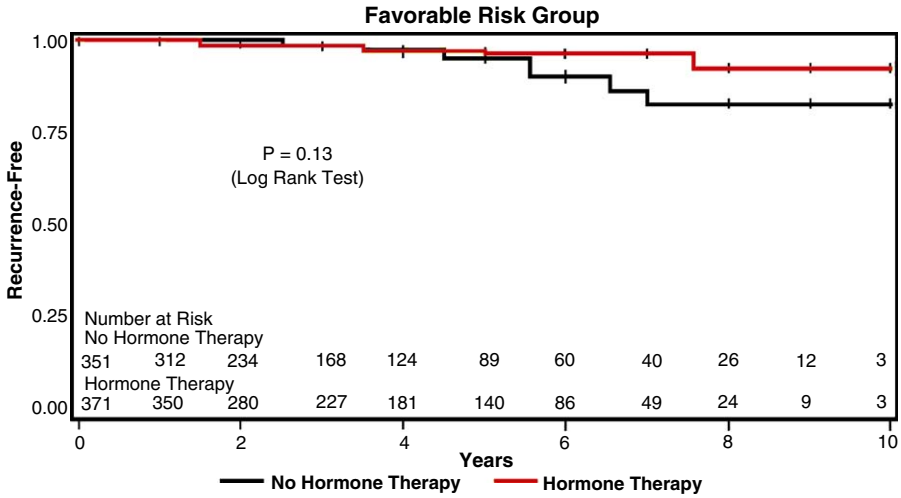

Fig. 8. Freedom from PSA recurrence (93% with HT vs. 84% non-HT) in favorable risk group.

brachytherapy programs are organized and led by radiation oncologists, which creates a very unique situation. Our patients come from our single group practice, which is not a referral center for either of the treatments discussed in this article. We work as a team with our radiation oncologist and physicist, and have trained our physician assistants to do the prostate ultrasound planning and intraoperative ultrasound guidance for the needles and seeds.

We feel the following conclusions have stood the test of time over the last 12 years:

1. Brachytherapy is a viable alternative to radical prostatectomy and external radiation therapy.
2. Brachytherapy results will continue to improve and give excellent 15-year cures.
3. It is minimally invasive.
4. Urologists can offer an unbiased alternative to radical surgery in appropriate cases, rather than being one-dimensional.
5. Brachytherapy is a valuable alternative to radiation therapy that results in fewer bowel and bladder complications.
6. We have a treatment option for those aged over 75 years, the largest growth segment of our population.

There have been many studies showing results of each therapy individually, seeds alone, and seeds and radiation therapy (5), but studies comparing all three treatments are rare. Recently, Potters *et al.* (11) published results of monotherapy treatments with permanent seed implantation, radical prostatectomy, or external beam radiotherapy for T1-T2 cancers over a 6-year period from two institutions. They reviewed the freedom from biochemical recurrence rates after

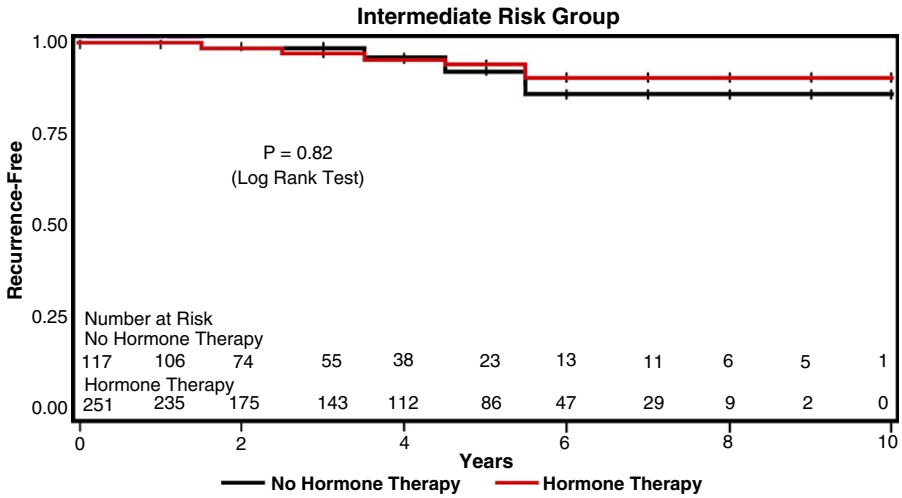

Fig. 9. Freedom from PSA recurrence (90% with HT vs. 86% non-HT) in intermediate risk group.

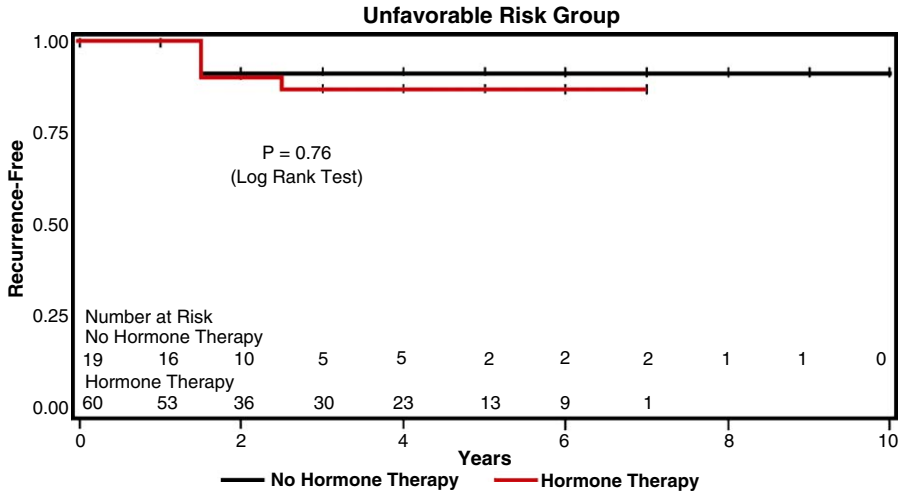

Fig. 10. Freedom from PSA recurrence (87% with HT vs. 92% non-HT) in unfavorable risk group.

permanent prostate brachytherapy, external beam radiotherapy (RT) to a minimum 70 Gy, or RRPP for clinically localized stage T1–T2 adenocarcinoma of the prostate.

The study cohort consisted of 1819 consecutively treated, clinical stage T1–T2 localized prostate cancer patients between 1992 and 1998. All patients received monotherapy treatment without additional adjuvant therapy. The median follow-up time was 58 months for all cases. Biochemical relapse was defined as detectable PSA levels in RRPP cases, and the ASTRO consensus panel definition for the RT and seed cases. Results of the 7-year seeds versus external beam RT versus RRPP were 74%, 77%, and 79%, respectively.

Potters *et al.* (11) concluded that pretreatment PSA levels and biopsy Gleason scores (like our risk groups) determined outcomes. We feel their data provides similar results to ours, but ours is from a single institution private practice group. We believe that brachytherapy should be offered to patients with localized prostate cancer. This method should not be dismissed without an unbiased comparison of current results and complications of both brachytherapy and radical prostatectomy. Over one decade of experience has convinced us that when patients are well selected and the implant procedure is performed with meticulous attention to technique by an experienced team comprised of urologist, radiation oncologist, and radiation physicist, brachytherapy offers a cure rate as high as prostatectomy with a lower rate of complications. We recently reviewed our techniques and improved equipment from 1995 to present and found major gains with both

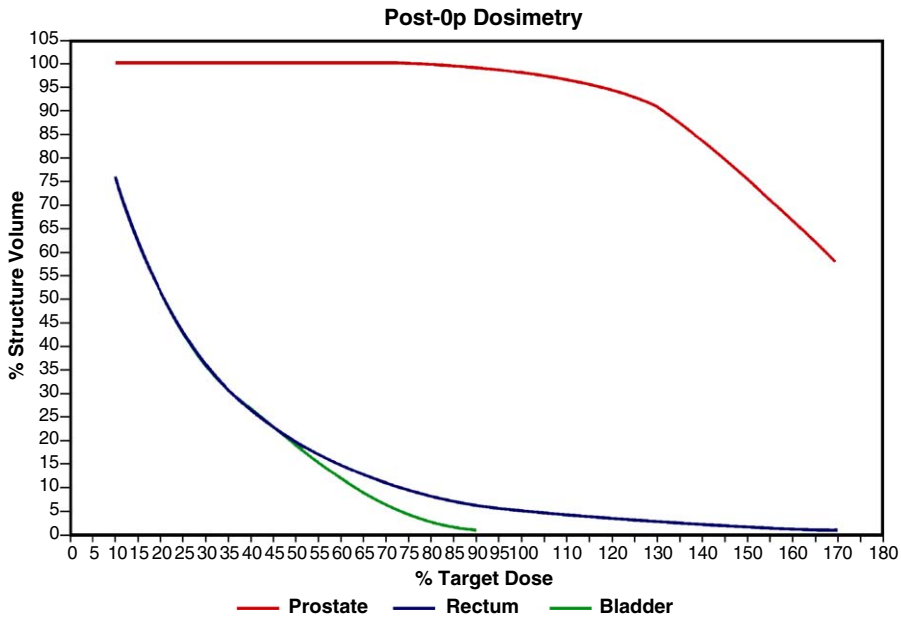

Fig. 11. Cumulative DVH.

brachytherapy and surgery. Low risk brachytherapy resulted in 99% freedom from PSA failure while surgery showed results of 97%. We used transperineal, ultrasound-guided, ^{103}Pd (exclusively as preferred isotope) TheraSeed implants (Theragenics Corp., Buford, GA) for T1 and T2 prostate cancer patients. We have found this to be a minimally invasive treatment that produces results comparable with those of radical prostatectomy, and ultimately, continued excellent quality of life for the patient.

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