

Radiation Therapy for Prostate Cancer - A Patient's Guide

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Your feedback

Your input helps us revise these guidelines periodically in order to keep them as relevant and useful as possible to the reader. We welcome and appreciate your comments, which could be sent to us via:

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Overview

Radiation therapy is an effective treatment for prostate **cancer**. Comparisons of **primary treatment** outcomes from the two most commonly used treatment options for prostate cancer, **radical prostatectomy (RP)** (see [Radical Prostatectomy - A Patient Guide](#)) and radiation therapy, have shown that long-term rates of cancer control are equivalent.

There is a risk of cancer recurrence after any primary treatment, whether the disease reappears in its original location or elsewhere in the body. The level of risk is influenced by several factors including **Gleason grade and score**, serum **prostate specific antigen (PSA)** level and velocity of PSA doubling time at diagnosis, the stage of the cancer, and volume of disease. Recent studies have suggested that genomic studies may also help determine disease aggressiveness. See <http://urology.ucsf.edu/359> (<http://urology.ucsf.edu/prostate-cancer-gene-expression-testing-at-ucsf>). For the patient, the decision regarding which treatment to choose is influenced by risk as described above as well as by patient age and health, personal preferences, and physician recommendations.

This guide is a brief introduction to radiation therapy and an explanation of how it is used as a treatment, primary or otherwise, for prostate cancer. It is not meant to be all-inclusive but rather to provide information to generate questions that may function as a starting point for discussions with your physicians. As you read through *Radiation Therapy for Prostate Cancer – A Patient's Guide*, words and terms in **bold** are defined in the GLOSSARY at the end of this guide.

What is the prostate gland and where is it located?

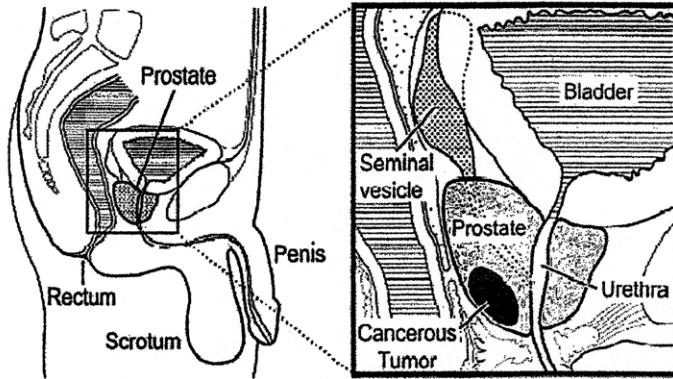


Figure 1: Male Anatomy

The **prostate gland** is located in front of the rectum and below the bladder. As a part of the male reproductive system, cells in the prostate secrete fluid that makes up part of the semen. Semen is the milky fluid that nourishes, carries and protects the sperm that are produced in the testicles.

The urethra, a hollow canal, starts at the bladder, passes down through the prostate and the penis, and drains **urine** from the bladder during urination or semen from the prostate during ejaculation. A small portion of the posterior prostate (the **peripheral zone [PZ]**) may be felt

by a medical practitioner during a digital rectal examination (DRE) when he or she inserts a lubricated, gloved finger into the rectum.

The prostate gland, stimulated by **testosterone** (a naturally occurring type of **androgen**), becomes enlarged in almost all men as they age. This process is called **benign prostate hyperplasia (BPH)**.

What is radiation therapy?

Radiation therapy uses **ionizing radiation** (x-rays, gamma rays; also called photons) and/or particle radiation (electrons and protons, positively or negatively charged particles respectively) to treat both benign (non-cancerous) and malignant (cancerous) tumors. Radiation is a form of energy that kills cancer cells by damaging their cellular DNA or by causing cellular reactions that damage DNA. This impairment to DNA prevents the cells from dividing and multiplying, kills the cancer cells and stops the cancer from growing.

Radiation is delivered in two main forms from: (1) outside the body (**External Beam Radiation Therapy [EBRT]**) or; (2) radioactive sources that are placed inside the body within or near the cancer or the organ containing the cancer (**brachytherapy**).

External beam radiation therapy may consist of conventionally fractionated radiation treatments delivered daily for 25 and up to 44 treatments approximately 5 minutes per day. With conventionally fractionated external beam radiation treatments, intensity modulated radiation therapy (IMRT) is often used to deliver dose with high conformity to maximize dose to the target while minimizing dose to the surrounding normal tissue including the bladder, rectum and small bowel. Another form of external beam radiation treatment is stereotactic body radiotherapy (SBRT). With SBRT, a high dose of radiation is delivered to the prostate in 4-5 treatments with each treatment lasting 30-50 minutes.

Two types of brachytherapy are performed at UCSF: 1) Low Dose Rate Brachytherapy which consists of the permanent placement of radiation sources into the prostate and; 2) High Dose Rate Brachytherapy which comprises the temporary placement of catheters into the prostate into which radiation sources can be temporarily administered and subsequently withdrawn. Brachytherapy may be used alone or in combination with external beam radiotherapy.

Clinical features such as the location, Gleason score, PSA and clinical stage along with patient preference and physician guidance determine the type of radiation used. The type of treatment selected affects the length of treatment and whether the treatment will be given on an outpatient or inpatient basis.

Some patients will receive **hormone therapy (HT)** before, during and sometimes after radiation treatment. The use and duration of hormone therapy and the type and duration of radiation treatment is determined by the stage and location of the cancer as well as by the purpose of the treatment (curing the cancer vs. symptom relief).

External beam radiation therapy: Three-dimensional conformal radiation therapy (3DCRT) and intensity modulated radiation therapy (IMRT)

During external beam radiation therapy, beams of ionizing radiation in the form of x-rays are directed at the treatment area from a machine outside the body (a **linear accelerator** or **linac**). The beams are focused and shaped to conform to the region being treated such as: (1) the prostate/prostate bed only or; (2) the prostate/prostate bed and **seminal vesicles** or; (3) the prostate/prostate bed, seminal vesicles and pelvic **lymph nodes**. The “prostate bed” is noted here for cases in which the prostate has been surgically removed, typically as a primary treatment, and usually before radiation therapy is employed.

In general, the scope of the region treated is determined by stage, Gleason score and PSA level. Information from imaging studies (**Computerized Tomography [CT scan or CAT scan]**), a magnetic resonance imaging (MRI) scan, positron emission tomography (PET) scan, and/or **transrectal ultrasound [TRUS]**) may also be considered. Treatments are given as an outpatient procedure either in a hospital or at an outpatient center. External beam radiation therapy may be given alone or with brachytherapy and with or without hormone therapy (**androgen deprivation**).

Three-dimensional conformal radiation therapy (3DCRT) and **intensity modulated radiation therapy (IMRT)** are image-based techniques used to design and deliver radiation treatment as forms of external beam radiation therapy. Both use radiographic images (CT scan and/or MRI scans) to obtain anatomic information that is used to plan treatment. Three-dimensional conformal radiation therapy creates shaped, or conformal, treatment fields to target the prostate..

Such fields are designed to follow the outline of the targets to be treated and to facilitate the precise blocking of the x-ray beam to minimize exposure of normal body tissues and sensitive organs to radiation. Image-based treatment permits accurate targeting of the treatment area, and three-dimensional conformal radiation therapy allows for the delivery of a uniform, conformal dose of radiation to that target.

Compared to 3DCRT, IMRT is a more sophisticated form of image based conformal therapy. For both, **treatment plans** are designed in a similar fashion and based on similar principles. The main difference is that the IMRT radiation beam is divided into hundreds of small beamlets, each of which can deliver a different radiation dose. This allows the dose of radiation to be modulated, within the area of treatment so as to further maximize the dose to the target.

The ability to vary the dose is extremely helpful when targeting radiation to an area (i.e., a malignant tumor) that is in close proximity to normal tissues (i.e., the prostate which you want to radiate vs. the bladder and the rectal wall for which you want to minimize radiation). Further questions between 3DCRT and IMRT are beyond the scope of this guide and may be discussed with your **radiation oncologist**.

What happens before and during external beam radiation therapy?

Patients preparing for treatment with 3DCRT and IMRT will have 1-2 appointments with their radiation oncologist before they receive any radiotherapy treatment. These appointments are called **simulation and verification sessions, respectively**. The purpose of these appointments is to create a treatment plan specific to the individual patient and verify that the treatment is deliverable and set up accurately. Each appointment will last approximately 30 minutes to 1.5 hours.

During the first simulation appointment, a CT scan will be taken. If you are having EBRT, you will be asked to take an enema to make sure the lower region of your rectum is empty. Sometimes an MRI scan is used with the CT scan for treatment planning. During the appointment, a series of ink marks may be drawn on your skin for reproducible positioning of your body for treatment.

You may be asked to have non-radioactive gold seeds implanted in the prostate or prostate bed to help with daily treatment setup. If so, the seeds are placed via transrectal ultrasound (TRUS) guidance d 5- 7 days before the simulation appointment. The discomfort from this procedure is usually less than what is experienced from a prostate biopsy.

A radiation treatment plan will be generated on the CT simulation scan using a sophisticated computer

program. In this treatment plan, the radiation beam arrangement, shape of each radiation beam, along with the dose delivery, will be optimized so that the dose to the prostate and other areas to be treated will be maximized and that surrounding normal tissue including the bladder, rectum and bowel will be protected from high radiation doses. After the treatment plan is designed by the radiation oncologist, you may have a 2nd appointment called verification. Verification ensures the course of radiation treatment aligns properly with your body as planned. You should speak with your radiation oncologist regarding the specific details of your treatment planning process. Treatment begins only after this process is completed and approved by your radiation oncologist.

After your radiation oncologist approves your treatment plan, radiation treatment will begin and be scheduled each day Monday through Friday. You will be assigned a time slot to be treated at the same time each day. A specifically trained **radiation therapist** will administer your treatment. The total prescribed radiation dose is divided into equal daily doses (fractions) and delivered to the treatment area each day over several weeks.

This strategy allows your healthy, non-cancerous tissues to repair between treatments. The cancer cells are not as efficient at repair. Fractionation (dividing the total radiation dose among the days in the treatment period) also allows different populations of cancer cells to be irradiated. During the course of your treatment, your treatment plan may be modified. For example, the size of the treatment field may be changed. If your radiation oncologist makes changes, any modifications will be planned and discussed with you.

During your treatment you will be asked to lay motionless on the treatment table. The area that is being treated is exposed (you may choose to wear a hospital gown) and positioned beneath the treatment machine (linear accelerator). The head of the treatment machine will move around your body to different angles, determined by the treatment plan, to deliver the radiation. Each treatment may take from 4-10 minutes. After each daily treatment, you will be able to perform your regular activities. You can expect to be in the Department of Radiation Oncology for approximately 30 minutes each day.

Permanent seed brachytherapy low dose rate (LDR) and temporary high dose rate (HDR) brachytherapy

Brachytherapy refers to a method of delivering ionizing radiation from radioactive sources placed either directly into a cancerous tumor or very close to it. These sources are typically encapsulated in small individual seeds as permanent prostate implants (**Seeds**) or attached to a long wire for **high dose rate (HDR) brachytherapy**.



Figure 2: A side view of the High Dose Rate Machine

One of the most important properties of brachytherapy treatment is the ability to deliver a very highly focused dose to the cancer. The effect of killing cancerous cells by the radioactive source drops off rapidly with increased distance (millimeters) from that source. Delivering a high dose at very close range maximizes delivery of treatment to the affected area while minimizing the radiation received by surrounding normal tissues.

For treating prostate cancer either, type of brachytherapy, permanent seeds or HDR, may be used alone or with EBRT, and with or without hormone therapy (androgen deprivation). Typically, brachytherapy is used alone for localized cancers (cancer with a low stage and low Gleason score) and in combination with EBRT for more advanced cancers.

Permanent seed brachytherapy

For permanent seed brachytherapy, planning occurs no more than 2 weeks prior to the scheduled implant date. At the planning appointment, images of your prostate will be taken by TRUS and your bladder function will be evaluated. HDR brachytherapy, like IMRT, is inverse-planned, meaning that the treatment plan is generated from a CT and/or MRI scan(s) that are taken after the thin tubes are placed

Permanent seed brachytherapy is a half-day outpatient procedure. It is performed under general or **epidural anesthesia**. Two different types of radioactive particles (isotopes), iodine-125 (I125) and palladium-103 (Pd103), are used for permanent seed brachytherapy. The half-life of an isotope defines the length of time it takes for the starting amount of radiation (100%) to decay by half

(50%). I125 has a half-life of 60 days and Pd103 has a half-life of 17 days. Each seed is smaller than a grain of rice, and approximately 60-80 seeds are placed in the prostate gland under transrectal ultrasound (TRUS) guidance during the implant procedure. The entire prostate gland is implanted with seeds, not just the areas in which biopsies show cancer. This is because the biopsy is a limited sampling of specimens from the prostate gland. Therefore, because some cancer could have been missed, the entire gland is considered to be at risk. The implant procedure takes only 45 minutes to 1 hour. If you are having this treatment, you will be taken to the recovery area after the seeds are placed, and you will stay there for several hours before going home.

For safety reasons, you will not be permitted to drive yourself home after the implant procedure. Before you leave the hospital, you will be given post-implant instructions and a card to carry with you that indicates the date of your implant and the isotope used. Once the seeds are placed, they remain permanently in the prostate gland, even after they are no longer radioactive.

Temporary high dose rate (HDR) brachytherapy

In temporary HDR brachytherapy, planning determines the locations within the catheter that the radioactive source will stop, and the length of time that the radioactive source will be applied.

Temporary HDR brachytherapy is generally a half-day outpatient procedure also. It is usually performed under epidural anesthesia. The isotope used for HDR brachytherapy is Iridium-192 (I192), which has a half-life of 74 days. A series of 14-16 thin tubes (**catheters**) are inserted through the skin into the prostate under **transrectal ultrasound (TRUS)** guidance. The catheters function as channels for the I192 to travel into the prostate.

A characteristic property of I192 is that it can deliver several hundred centigray (cGy, a unit of radiation) to the prostate cancer in 5-10 minutes. Usually only one treatment is required. In special circumstances

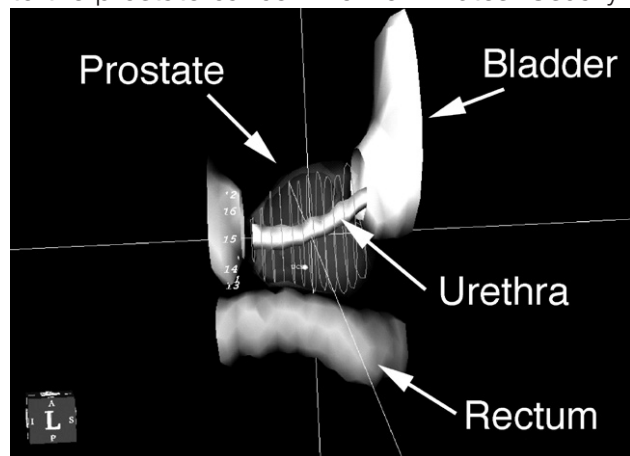


Figure 3: Digital reconstruction of prostate and surrounding organs; typical image used for HDR brachytherapy planning

in which patients are receiving re-irradiation, six individual HDR brachytherapy treatments may be given to complete the course of treatment. After the radiation is delivered, the thin tubes are removed and no radiation remains in the prostate gland.

While you are in the hospital for your HDR brachytherapy treatment, you will be required to remain in bed, lying relatively flat. You can turn onto your side with assistance and bend your knees. You will not be able to get out of bed to walk or go to the bathroom. You will have a **Foley catheter** inserted to collect urine directly from your bladder.

On the morning of the procedure, you will be asked to take an enema to empty the rectum. For safety reasons, you will not be permitted to drive yourself home after the HDR procedure.

What is “hormone therapy” and when is it given with radiation therapy?

Hormone therapy (HT) is a treatment that may be used in conjunction with radiation therapy to help control prostate cancer. Several studies have shown that this combination improves the outcome of PSA levels, local disease control, distant metastases free survival and overall survival in patients with more aggressive prostate cancer. The term hormone therapy is confusing because the treatment actually involves blocking your body’s production of the male sex hormone testosterone (**androgen**). This is accomplished using a combination of two different medications:

- 1) a **luteinizing-hormone releasing hormone (LHRH) agonist or antagonist** (agonist: goserelin, marketed as Zoladex or leuprolide, marketed as Lupron; antagonist: degarelix, marketed as Firmagon)

and

- 2) a non-steroidal **anti-androgen** (bicalutamide, marketed as Casodex or flutamide, marketed as Eulexin).

For this reason, hormone therapy is often called androgen deprivation therapy (ADT). Again, the stage, Gleason score and grade, and extent of the cancer determine if your physician recommends HT, the timing of HT with radiation and duration of HT.

Goserelin (Zoladex) and leuprolide (Lupron) are different forms of the same agent. They work the same way and are equivalent in their effects. Both are administered by injection in time-release preparations as follows: (1) Lupron: 1-month, 3-month, 4-month & 6-month; (2) Zoladex: 1-month & 3-month. Likewise, bicalutamide (Casodex) and flutamide (Eulexin) are different forms of the same agent. These, however, are oral medications (pills) that are taken 1 to 3 times a day.

Two additional oral medications have been used together with the above medications. However, controversy remains regarding their benefit. Finasteride (Proscar) and dutasteride (Avodart) are **5-alpha reductase blockers** that are often prescribed for men with benign enlargement of the prostate gland (BPH). These medications block the conversion of testosterone to the more potent **dihydrotestosterone (DHT)** within the prostate gland.

General strategies for the use of hormone therapy and radiotherapy in the management of localized prostate cancer

The matrix below indicates when hormone therapy may be recommended and for how long. You should discuss your specific case and the recommended outcome with your physician.

Prostate Cancer Risk Group *

	Low	Intermediate	High
EBRT Treatment Field	Prostate/ Prostate bed	Prostate/prostate bed	Prostate +/- pelvic lymph node regions
Hormone Therapy: Timing & Duration	Not recommended	0 or 4 months; If 4 months, 2 months before EBRT & 2 months during EBRT	2 months before EBRT & 2 months during EBRT & after EBRT (greater than or equal to 2 years total)

* Low-Risk = stage T1-T2b & Gleason Score 6 or less & PSA less than 10 ng/ml;
Intermediate-Risk = stage T2b and/or GS 7 and/or PSA 10-20 ng/ml;
High-Risk = stage T2c or higher or GS 8-10 or PSA greater than 20 ng/ml

HT can also be used to shrink the size of your prostate gland before LDR brachytherapy treatment. It is usually not necessary for HDR brachytherapy treatment. When HT is used to shrink the prostate gland for LDR brachytherapy, HT treatment typically lasts 2-3 months. A transrectal ultrasound (TRUS) may be performed after 2-3 months to evaluate the change in the size of your prostate. If you are having brachytherapy as a therapeutic **boost** after EBRT, you may not need to have HT to shrink an enlarged prostate.

What are the side effects of hormone therapy?

The side effects of HT are the result of lowering or blocking your body's production of testosterone. Though these are not the only side effects, most men experience hot flashes and loss of sex drive (libido). Some men have difficulty or inability achieving an erection, fatigue, mild anemia, weight gain, increased appetite, softer skin and diarrhea. In rare instances impaired liver function, breast tenderness and breast tissue growth (**gynecomastia**) may occur. Rarer still are depression and other mental status changes.

Long-term use of hormone therapy can cause a loss of calcium from the bones which results in bone loss. Calcium loss is reversible. Patients who have taken HT for more than a year, or who have a history of malnutrition, **osteoporosis** or **osteopenia** should inform their physician. The physician may recommend calcium supplementation or additional therapy.

Physical activity, including weight-bearing exercises, will help prevent further bone loss. If your treatment plan includes extended use of HT, your physician may recommend a baseline bone densitometry test. Infrequently, the side effects from HT are so bothersome that hormone therapy may be discontinued.

In general, side effects will begin to diminish after HT is discontinued. However, with longer periods of hormone therapy, treatment recovery may be less complete. As testosterone gradually increases, the symptoms gradually diminish. On average, 8-10 months are needed to "fully" recover from the effects of hormone therapy. Longer periods of HT treatment will require a longer recovery period.

Why would I choose radiation therapy?

Radiation therapy (EBRT and brachytherapy) is a standard of care treatment for prostate cancer and also an alternative to other forms of primary treatment (active surveillance, cryotherapy, surgery, etc.) for men with prostate cancer. EBRT may also be used after another primary treatment for prostate cancer, including surgery, to manage cancer that has recurred or is at a high-risk of recurring. You should discuss all treatment options with your physicians.

Radiation therapy has an excellent record of treatment success. Radiation therapy provides long-term disease control with survival rates equivalent to other forms of treatment. Like other treatments, radiation therapy has benefits and risks that may affect a patient's quality of life.

Long-term survival rates following treatment for prostate cancer have improved and, therefore, the impact of treatment on a patient's quality of life may influence his choice of treatment. These effects will be discussed more fully in the section entitled What should I expect during and after radiation therapy?

How should I expect to feel during radiation therapy?

Undergoing external beam radiation therapy is similar to having a routine x-ray and is no more uncomfortable. Radiation cannot be seen, smelled, or felt. You may, however, experience side effects from the treatment. Generally, side effects do not appear until the 2nd or 3rd week.

Radiation therapy is a local treatment, and any side effects will primarily involve the area of the body where the radiation is directed. Patients may experience some or all of the following:

- an increase in the frequency of urination
- urinary urgency
- weak urinary stream
- difficulty starting urination
- mild burning or tingling with urination
- loose stools, and less often, diarrhea
- softer and smaller volume bowel movements
- increased frequency of bowel movements
- worsening of existing hemorrhoids or, rarely, rectal irritation with occasional scant blood.
- Generalized fatigue of varying severity may also be experienced. Patients receiving radiation therapy are usually able to continue to work or function normally.

Depending on the severity of these side effects, you may be prescribed medications for symptom relief such as an anti-diarrhea medication (i.e., Imodium AD or Lomotil) or a medication to decrease the frequency of urination (i.e., Flomax or Uroxatral). Most of these symptoms are short-term (acute) and will go away after radiation treatment ends. The time for full “recovery” depends upon the patient and the type and severity of urinary or bowel symptoms he had (if any) before treatment.

As part of your treatment planning, you will be asked to fill out questionnaires to help evaluate your bladder function. It is important to discuss the nature and severity of your particular symptoms with your physician, as this may influence your treatment course. Patients typically continue with their normal daily activities during treatment.

How should I expect to feel after radiation therapy?

After completion of external beam radiation therapy, you may have urinary and bowel side effects that may continue for 2-6 weeks, but they will lessen as time passes. You may need to continue taking prescribed medications during treatment. Some patients report continued but lessening fatigue for several weeks after treatment ends. Other minor problems may include dry itchy skin, a sensation of heaviness in the **perineum**, anal and rectal irritation and flare up of hemorrhoids. Patients usually continue with their normal daily activities.

After brachytherapy, patients may experience burning with urination, increased daytime and nighttime frequency of urination, slow or weak urinary stream, incomplete emptying of the bladder, a brief period of blood in the urine (usually in the immediate post procedure period), perineal pain or soreness, scrotal bruising and/or swelling, blood spotting from the perineum, nausea from anesthesia and fatigue.

Most patients continue with their normal daily activities soon after brachytherapy. Limiting heavy lifting and strenuous physical activity for 2-3 days after the implant is recommended. In less than 10 % of patients, swelling of the prostate may cause obstruction of outflow from the bladder. If this happens, the patient may go home with an inserted Foley catheter and will be prescribed a medication to help reduce the swelling and inflammation.

Without a Foley catheter, it's rare that a patient is unable to urinate several hours to a day after going home. If this does happen, the patient must visit his physician or go to the nearest emergency room so that a Foley catheter could be inserted. The catheter is usually removed after 3-7 days. Rectal symptoms are not common after brachytherapy. Patients may experience some rectal discomfort after the procedure but rectal bleeding is uncommon.

Radiation safety is a common concern for patients undergoing external beam radiation therapy and brachytherapy. Patients are given detailed written instructions before going home. After discharge, there are no radiation safety issues for EBRT and HDR brachytherapy patients, and there is no need for patients to isolate themselves from family and friends because the treatments are not dangerous to others. Once a patient's daily treatment is completed, there is no radiation remaining in his body.

For patients treated with permanent seed brachytherapy, most of the radiation from the implant is absorbed by the patient's body tissues. Neither bodily wastes nor items that come into contact with the patient are radioactive. However, we do recommend that during the first 1-2 months after permanent seed implantation that women who are pregnant or may become pregnant maintain a distance of six feet or more from the patient, if they will be in the patient's company for a prolonged period of time. In addition, it is recommended that young children and pets not be allowed to rest on the patient's lap for prolonged time periods. Sexual intercourse may be resumed at any time after the seed implant; we recommend a condom be worn for the first week after the procedure.

Sexual function

Some men may experience a decline in their erectile function (**erectile dysfunction** or **impotence**) after radiation therapy. The likelihood of impaired potency is also influenced by patient age (the primary risk factor), the use and duration of HT, smoking history and other medical conditions such as hypertension, diabetes and the medicines used for their treatment.

For some patients, erectile function declines slowly over the first five years after radiation treatment. The effects of short-term HT (4-6 months) appear to be largely reversible. Similar levels of sexual function are reported 4 years after treatment by patients who received HT and by patients who did not receive HT. Patients may develop some degree of erectile dysfunction after brachytherapy; however, treatment-related erectile dysfunction may be less likely after brachytherapy than other forms of treatment. Most men who are not taking **nitrate-containing medications** will be able to use any of the oral impotence medications on the market. These medications improve erectile quality with excellent success.

Patients may experience a prolonged time to achieve orgasm. Some patients who have had RT but have not had their prostate removed experience a change in the nature of their ejaculate (thicker, less fluid) and a decrease in the quantity or an absence of ejaculate after radiation treatment. This is usually more common with EBRT than brachytherapy.

Following brachytherapy, the ejaculate may be discolored (dark-brown or even black). The discoloration is due to "old" blood that is residual from the procedure. It is harmless and of no risk to the patient or their sexual partners. The ejaculate will become clear over time. Sexual function is discussed in detail in the [Your Health Matters Managing Erectile Dysfunction – A Patient Guide](#).

Sperm production

Sperm are produced in germinal cells in the testicles. During prostate radiation, low levels of **scatter radiation** scattered inside the body from the treatment beam can reach the testicles and decrease sperm production. The dose of radiation that reaches the testicles usually leads to a temporary reduction (months to years) in the sperm count. It is possible, however, to have a permanent reduction in the sperm count (sterility). If you are considering fathering children, you may wish to seek medical advice regarding your fertility and the need to bank sperm prior to treatment.

Testosterone production

Testosterone is secreted by the cells in the testicles. In general, the doses of internal scatter radiation that reach the testicles are not high enough to completely impair the ability of these cells to produce testosterone.

What else do I need to know?

On occasion, the EBRT treatment machines “go down” and treatment cannot be delivered. This occurs unexpectedly for a variety of reasons. If any aspect of the machine’s normal function is irregular, a safety feature stops the machine from working and treatments cannot be given. When this happens, you will have treatment on another machine, wait until the problem is resolved or skip treatment that day. You will be asked to skip a treatment only when a longer evaluation and repair time are needed. If you miss a treatment, it will be made-up so you receive the dose of total radiation for the course of treatment prescribed by your physician.

Many questions may arise during radiation therapy treatment, not all of which can be anticipated or answered here. Your physicians will be available to answer questions throughout your treatment.

Troubleshooting

Mild fatigue may occur during EBRT treatment. If this happens, consider taking a nap during the day. If you are working, consider decreasing your work hours or taking a leave. However, do try to remain physically active and eat a well-rounded diet. Nutritionists are available at the UCSF Cancer Resource Center to provide dietary assistance. Contact your physician if your fatigue becomes severe.

Diarrhea, flatulence or painful defecation are not uncommon and may occur after the second or third week of treatment. These symptoms will go away after the treatment ends. During radiation treatment, dietary modification usually helps reduce the frequency and severity of diarrhea. Try to avoid or reduce fried foods, greasy foods and highly spiced foods. Cut down temporarily on foods with insoluble fiber (i.e., lettuce, cauliflower) and increase low-fiber and soluble-fiber foods (i.e., bananas, mashed potatoes, applesauce, white rice, canned or cooked fruits and vegetables).

Maintain your intake of lean proteins (i.e., turkey, chicken and fish) and increase your fluid intake to avoid dehydration. The use of moist toilet paper, baby wipes or sitz baths may help relieve rectal irritation. Your physician may recommend the use of anti-diarrheal medications. Contact your physician if you see blood in your stool, if the diarrhea worsens or if you become light-headed or dizzy.

Frequent urination, burning with urination and difficulty urinating are the most common complaints of patients receiving radiation therapy for prostate cancer. Occasionally, the urinary stream will weaken. Generally, these symptoms are not severe and are managed with medications that help the bladder function better or eliminate burning. Rarely, your physician may order a urine test. These symptoms will go away after the end of treatment. Contact your physician if you see blood in your urine or if you are unable to urinate.

Swelling, bruising or tenderness of the scrotum may occur after brachytherapy. Symptoms usually go away on their own within 3-5 days. Oral anti-inflammatory medications, such as ibuprofen, are usually sufficient for pain relief. You should avoid hot tubs and Jacuzzis for at least 2-3 days after the procedure. Do not go bike riding until tenderness has gone away.

Skin irritation is uncommon, but if it occurs do not rub or scratch the area. Try to avoid clothing that is too constrictive and avoid lotions or colognes containing alcohol. Your physician can recommend a skin care regimen and topical creams or lotions to relieve the symptoms. Contact your physician if you develop a rash all over your body.

Follow-up: How often will I need to see my doctor?

Following EBRT, you will have an initial appointment to make sure that treatment-related side effects are diminishing or have gone away. The frequency of follow-up appointments will be determined by your risk of cancer recurrence. In general, serial PSA blood tests will start around the third month after treatment completion.

Testing typically occurs every 3-4 months during the first 2-3 years after completing treatment and then every 6 months thereafter. Changes to this schedule may be made during your follow-up evaluations. Patients receiving LDR brachytherapy will have an appointment for a CT scan of the prostate approximately 3-4 weeks after the procedure. This CT scan will be used to evaluate the “quality” of the implant. Generally an appointment in the Department of Urology will also be scheduled for the same day.

How will I know if the treatment is working?

Serial PSA blood tests are how you will be monitored after definitive treatment of your prostate cancer. Following radiation therapy, your PSA should fall, but will not reach its lowest value PSA (nadir) immediately after treatment. It may take up to 2-3 years for the PSA to reach its nadir. Keep in mind that the PSA may not decline steadily.

Temporary increases, also called spikes or bounces, in PSA may occur during the first 12-36 months after completion of EBRT or brachytherapy. These bounces are not signs of treatment failure. The pattern of PSA decline may not be steadily downward. For patients on hormone therapy, both testosterone and PSA levels usually decrease. As your testosterone recovers, your PSA may rise. This increase is not considered a bounce or spike and is not a sign of treatment failure.

There is much debate over the most accurate means to detect treatment failure after treatment with radiation therapy. A consensus definition was established several years ago in an effort to systematize the evaluation of treatment outcomes. This definition defines treatment failure as three consecutive increases in the PSA value after the nadir has been reached. More recently, a PSA level that rises to an absolute value of 2 above the nadir has been shown to strongly associate with subsequent disease progression, but often times, further treatment is initiated before PSA levels rise to a level of 2 above nadir.

PSA testing remains an important monitoring tool and serial testing at regular intervals is critical to its effective use. Your physician will evaluate additional data in conjunction with PSA test results to effectively monitor your treatment outcome.

Will I need additional treatment?

Usually no additional treatment is needed after radiation therapy. The need for additional treatment is determined by PSA levels, Gleason score, stage of the prostate cancer and whether you had your daily treatments as scheduled, particularly for EBRT.

Regular post-treatment PSA evaluation is important in monitoring and evaluating the need, if any, for additional treatment. Should the cancer recur, the options for treatment will, in part, depend upon the initial treatment. Additional alternative forms of radiation therapy, prostatectomy, cryotherapy, hormone therapy or new treatments under evaluation in **clinical trials** may be recommended. Your team of physicians (radiation oncologist, urologist and medical oncologist) will discuss appropriate treatment options and recommendations with you.

GLOSSARY

(The first usages of glossary terms are **bolded** in the text.)

Adjuvant – Assisting or aiding. Used to describe additional treatments administered in addition to a definitive therapy. For EBRT, this usually refers to androgen deprivation given after ERBT is finished.

Androgen – A hormone with masculinizing properties, i.e., testosterone. Androgens stimulate growth of both normal prostate and most malignant prostatic cells.

Androgen deprivation – A therapeutic strategy designed to decrease circulating levels of the male androgen testosterone and its related compounds. Androgen deprivation can be done by removing the organs that produce testosterone (i.e., removing the testicles; orchiectomy) or by giving medication (see hormone therapy).

Anti-androgen – Oral agents flutamide (Eulexin) and bicalutamide (Casodex) that block the action of testosterone and its active metabolite dihydrotestosterone (DHT) at the cellular level by interfering with androgen receptor interactions.

Applicator – A device used to deliver or hold a radioactive source during brachytherapy.

Benign prostatic hyperplasia (BPH) – Non-cancerous enlargement of the prostate gland, which often results in difficulty with urination. The incidence increases with age.

Biopsy – Sampling of tissue.

Blocks – Pieces of metal alloy that can be used to shape the EBRT beam.

Bone scan – A nuclear medicine imaging study that utilizes a radioactive compound injected into a vein to identify areas of increased bone cell activity in the skeleton; used to screen for the presence of bone metastases.

Boost – An additional dose of radiation that is given after an initial course of treatment to enhance tumor control.

Brachytherapy – In radiation therapy, treatment with ionizing radiation that is applied directly into an organ that has cancer. For prostate cancer, this consists of implantation of radioactive material into the prostate. Also called implants or seeds.

Cancer – A group of diseases characterized by uncontrolled cell growth. Cancer cells, unlike benign cells, exhibit the properties of invasion and metastasis.

Catheter – A general term for a tube that is inserted to drain fluids from or instill fluid into the body.

Cell – The fundamental structural and functional unit of living organisms.

Centigray (cGy) – The measurement of radiation delivered to a tumor. A gray (Gy) is a unit of absorbed energy dose.

Clinical trial, Phase 1 – A clinical trial designed to determine the appropriate dose and toxicities of an investigational agent or treatment.

Clinical trial, Phase 2 – A clinical trial designed to determine the effectiveness and side effects of an investigational agent or regimen.

Clinical trial, Phase 3 – A clinical trial designed to test the effectiveness of a given treatment as compared to existing treatments.

Clinical trial, Randomized – A clinical trial in which the effectiveness of two or more treatments are compared. Random assignment of patients to one treatment or another ensures that clinical features are balanced.

Clinical trial controls – A standard against which experimental observations may be evaluated, as a procedure identical in all respects to the experimental procedure, except for absence of the one factor that is being studied.

Computerized tomography (CT scan or CAT scan) – Also called computer assisted tomography. A radiologic imaging study in which cross-sectional images of the body are obtained. For EBRT, CT scans are used for treatment planning.

Concurrent – Simultaneous. With EBRT usually refers to androgen deprivation that is given during the course of treatment.

Dihydrotestosterone (DHT) – A derivative of testosterone, which has a higher biologic activity within the prostate than testosterone; blocked by 5-alpha reductase blockers.

Electronic portal image (EPI) – an electronic image produced using a flat panel.

Epidural anesthesia – A catheter is inserted into the space surrounding the spinal cord to give medication to block pain. Used after radical prostatectomy or during HDR brachytherapy.

Epithelial cells – Cells that line body surfaces and cavities. These are the cells that produce secretions (such as PSA in the prostate) and are the cells from which (by definition) carcinomas are derived.

Erectile dysfunction (ED) – see impotence

External beam radiation therapy (EBRT) – High-energy x-rays or protons used to kill cancerous tissue in the prostate, and elsewhere in the body.

5-alpha reductase blockers – A medicine that blocks conversion of testosterone to dihydrotestosterone inhibiting prostate growth.

Flat panel – a sensitive device that detects x-rays. The image produced is digital and can be immediately processed electronically. Image production requires less energy than x-ray film. May be used to position patients and/or detect organ motion.

Foley catheter – A tube that is placed into the bladder used to drain urine.

Gantry – The part of the linac that moves around the patient and functions in the delivery of EBRT.

Gleason grade and score – The **Gleason grade** is a numerical value given to prostate cancers that describes the level from which normal cell tissue has progressed from a low to an aggressive form of cancerous tissue within the prostate. Grades are assigned to the most common pattern of cancer as well as the second most common. Grades for each pattern range from 1 to 5. A grade of 1 denotes a cancer that closely resembles benign or normal tissue. A grade of 5 is assigned to cancers that appear most aggressive and differ significantly from benign tissue. The **Gleason score** is obtained by adding together the 2 Gleason grades and can range from 2 to 10.

Gynecomastia – Enlargement of breast tissue in a man. May occur with the use of androgen deprivation.

High dose rate (HDR) brachytherapy – A focal radiotherapy treatment involving temporary placement of a radioactive source in the prostate that is removed after each treatment. Small flexible tubes are inserted into the prostate through the perineum to deliver a high dose of radiation in a short period of time (5-20 minutes).

Hormone therapy (HT) – see androgen deprivation

Immobilization device – An external device used to help the patient remain in the same position for every treatment.

Implant – See brachytherapy

Impotence – Erectile dysfunction. The inability to achieve an unassisted erection sufficient for satisfactory sexual intercourse. This topic is covered in detail in Your Health Matters - Managing Impotence – a Patient’s Guide.

Intensity modulated radiation therapy (IMRT) – An advanced form of 3D-CRT (see below) that selectively raises doses at different places on the prostate and spares normal tissue with great precision.

Implant – A type of brachytherapy in which radioactive material (seeds) are implanted into the prostate.

Ionizing radiation – A general term for particle beams that trigger ionization (excitation) of an atom or molecule. Ionizing radiation transfers energy into the tissues in which it is deposited.

Linear Accelerator (linac) – A machine used to deliver External Beam Radiation Therapy (EBRT).

Luteinizing hormone releasing hormone (LHRH) agonist – Synthetic analogs of natural gonadotropin-releasing factor that induce a temporary increase in testosterone secretion followed by fall of testosterone to castrate levels.

Lymph node – Filter nodules that are part of the body’s drainage system for fluids. Also serves as a component of the immune system by removing bacteria, foreign particles, cancer cells, etc. from the circulation. Often the site of tumor metastases.

Metastasis – Secondary growth of a cancer due to the spread of cancer cells away from the site of origin. The capacity to metastasize is a characteristic of malignant tumors.

Multi-leaf collimator (MLC) – A part of the linear accelerator that is used to shape the EBRT beam.

Neoadjuvant – A treatment that is given before definitive local therapy. For EBRT, this usually refers to androgen deprivation given before the start of treatment.

Nitrate Containing Medications – An example medication is nitroglycerin which is used by some patients with heart disease (angina).

Orchiectomy – Surgical removal of the testicles to eliminate testosterone; used to treat advanced prostate cancer.

Osteopenia – Decreased calcification or density of bone.

Osteoporosis – A reduction in the quantity or amount of bone; skeletal atrophy.

Perineum – The area of the body between the anus and the base of the scrotum. In brachytherapy, needles containing radioactive seeds or in HDR brachytherapy thin tubes are implanted in the prostate through the perineum. (Perineal is the adjectival form.)

Prostate gland – A gland in the male that surrounds the neck of the bladder and urethra. Secretions produced in the prostate contribute to the seminal fluid.

Prostate specific antigen (PSA) – A protein produced by prostatic epithelial cells. The level of PSA often correlates with the likelihood and extent of prostate cancer and the size of benign prostatic enlargement (BPH).

PSA nadir – The lowest point to which a patient’s PSA drops on a PSA blood test, following definitive treatment.

Peripheral zone (PZ) – The rear outer area of the prostate gland where over 80% of prostate cancers originate.

Primary treatment – The first, or only, treatment given for a disease. It is often part of a standard set of treatments, such as surgery followed by chemotherapy and radiation. When used by itself, primary treatment is the one accepted as the best treatment. If it doesn’t cure the disease or it causes severe side effects, other treatment may be added or used instead. Also referred to as first-line therapy, induction therapy or primary therapy.

Radiation oncologist – A physician who specializes in treating cancer with radiation therapy.

Radiation therapist – A person who is specifically trained to operate a linear accelerator and administer radiation therapy treatments.

Radical prostatectomy (RP) – A surgery in which the entire prostate gland and seminal vesicles are removed.

Scatter radiation – Low levels of radiation scattered inside the body from the treatment beam during prostate radiation.

Seeds – See brachytherapy

Seminal vesicles – Paired glands located on either side of the prostate that secrete substances to nourish sperm.

Simulation and verification – The process of planning radiation therapy. For EBRT usually includes x-rays and a CT scan.

Testosterone – The male sex hormone or androgen that causes characteristically male features; predominantly produced in the testicles.

Three-dimensional conformal radiation therapy (3DCRT) – A means of delivering external beam radiation therapy that results in high doses delivered to the target with less exposure to surrounding tissue.

Transrectal ultrasound (TRUS) – An imaging test in which an ultrasound probe is placed into the rectum to image the entire prostate. This test facilitates prostate cancer staging and prostate biopsy.

Treatment plan – A radiation oncologist's prescription that describes how a patient should be treated, including the dose of radiation to be delivered, and the organs to be treated and protected.

Urethra – A structure that drains urine from the bladder. It passes through the prostate gland (prostatic urethra) and through the penis (penile urethra).

For additional information about radiation therapy, please go to the following web sites:

The UCSF Department of Radiation Oncology:

<http://www.ucsf.edu/radonc>

The UCSF Medical Center:

http://www.ucsfhealth.org/adult/medical_services/cancer/urologic/index.html

The Comprehensive Cancer Center:

<http://cancer.ucsf.edu/>

Important Information and a Phone Number

UCSF Cancer Center:

415-353-7171

This is a 24-hour number. Normal office hours are 9 AM to 12 PM and 1 PM to 5 PM. Outside of the normal office hours, either your doctor or the doctor on call could be contacted for questions.

