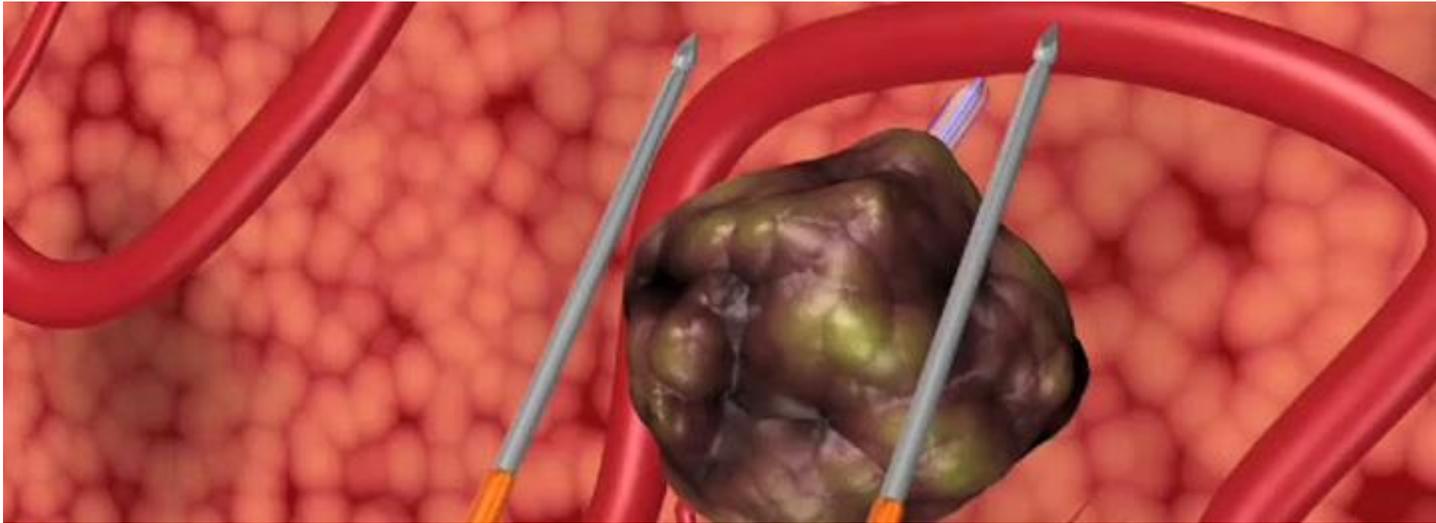


## NanoKnife (IRE) - the latest prostate cancer therapy



A new type of treatment method for prostate cancer, irreversible electroporation (IRE), also called NanoKnife® treatment, is opening up new options for **prostate cancer therapy – with a minimum of side effects.**

Current treatment methods lead to impotence (loss of erection ability) and incontinence (loss of bladder control) in the majority of men, but these side effects can usually be avoided by using NanoKnife® treatment. The significance of this paradigm shift in prostate cancer therapy becomes clear in light of the fact that one in six men gets prostate cancer. Besides, prostate cancer used to be primarily an old man's illness, but younger men are now contracting it in increasing numbers.

In NanoKnife® treatment, strong electric fields cause cells to die without exposing the tissue to radiation or heating it. This so-called irreversible electroporation (IRE) reliably destroys tumor and parenchyma cells. But important anatomical structures in and around the prostate such as nerves, the intestinal wall, the sphincter, veins and arteries are spared. Erection and bladder control are thus spared.

### NanoKnife technology - predestined for applications such as prostate cancer

Irreversible electroporation (IRE, NanoKnife®) is based on ultrashort pulsed, extremely strong electrical fields. As compared to all standard procedures, this new technology has unique characteristics that predestine it for use in the prostate:

- **Tissue selectivity:** Only cells with a membrane (such as cancer cells) are reliably destroyed, while all other structures (nerves, arteries, connective tissue structures, etc.) remain unharmed.
- **Ultrasharp edges:** Radiation and heat-based therapies always produce an area – often several centimeters in diameter – containing tissue that is unintentionally damaged. With IRE, the line between "completely removed" and "undamaged" is measured in micrometers.
- **Induced cell death:** IRE induces cell death, or apoptosis, but not radiation damage or burning and consequently no scarring. With current standard procedures such as radiation

(proton, Brachy, etc.) or heat therapies (HIFU, etc.), a large "toxic" area occurs because the burned tissue is a toxin for the body. The result is inflammation and pain, followed by scarring, all of which prevent or hamper any subsequent treatment that may become necessary in case of a recurrence.

- **No limit on repeated treatment:** Because IRE therapy does not cause scarring, treatment using all other techniques (radiation, heat, surgery) is still possible without limitation after IRE therapy, or IRE can be repeated as often as necessary.
- **Painless and minimal-invasive:** For the reasons mentioned above and because thin needles are the only invasive instrument used, patients usually do not even feel the therapy at all.
- **Quick and in one session:** In one single session under general anesthesia, even extensive areas can be treated.
- **Broad spectrum of uses:** Although small, early detected prostate cancer tumors definitely represent the simplest use, NanoKnife® therapy is also a potential treatment method for inoperable carcinomas that have penetrated the prostate capsule as well as recurrences after radiation therapy, radical removal of the prostate, HIFU or Brachy therapy.
- **Immune system:** The tumor proteins released during IRE help the patient's immune system to fight any other tumors. [[Find out more about this here.](#)]

IRE as a technique has been certified by the FDA and CE since 2006. It received certification because it was possible in all studies to demonstrate the reliable killing of all cells in a defined area in soft tissue. Nevertheless, two factors are critical for the success of any NanoKnife® therapy:

The first is the absolutely correct and precise knowledge of the location of the tumor before treatment.

The second is placement of the electric field in the right position.

The first factor is achieved using multiparametric MRI examinations, 3-d biopsies and other procedures as necessary at the Institut für Bildgebende Diagnostik (Institute for Imaging Diagnostics), which has specialized in this procedure for ten years.

The second is achieved by minimally invasive surgery under general anesthesia in which sterile needles with variable exposition length are introduced. "Exposition length" refers to the length of the part of the needle that touches tissue with electric current. With over three years of experience and the largest number of prostate treatments worldwide, we are the world's leader, while others in Germany are just starting.

## What are the Steps in a NanoKnife treatment of Prostate Cancer?

[If you seek for a detailed look on the IRE technology and how it kills cancer cells, we have a article for you here.](#)



### Step 1: Planning

This could be considered the most essential step. NanoKnife® therapy is a focal, image-assisted

therapy; its results are only as good as its diagnostics and planning. The NanoKnife® cannot decide for itself where the cancer is. As a patient, you should not compromise when it comes to diagnosis. All forms of ultrasound (including elastography or contrast-enhanced ultrasound) as well as rectal punch biopsies have frighteningly low detection rates. It is very unlikely that (all) of the tumor(s) can be seen.

At present, adequate imaging diagnoses are only provided using multiparametric MRIs performed by specialized radiological institutes, along with PSMA/choline PET-CTs if necessary. [Ask our experts now. ] Another dimension is brought into the 3-d images using 3-d saturation biopsies. We specialize in both. Both are necessary to achieve the precision necessary to make NanoKnife® therapy valid at all, and the use of both explains our 0% recurrence rate after initial treatment over more than three years.

Once our physicians and physicists have planned the target area on the MRI's cross section images and, if necessary, precalculated it using 3-d simulations - as developed by us - of the area to be treated, the target area is saved and transferred to the operation monitor on the operation day.



### **Step 2: Placing the electrodes**

When the prostate is being treated, the needles are inserted transperineally, i.e. through the region between the anus and the genitals. An endorectal ultrasound aids in placement. This is where experience is vital. Even two needles can place demands on the operator's three-dimensional spatial visualization ability, but more complex placements with many needles are extremely challenging. This is because the prostate is a relatively small organ that has a complex geometry and is surrounded by vital areas. Furthermore, the possible positioning of the needles is subject to strict limitations. Although at the Prostate Center various computer software applications aid us in achieving perfect placement, this process can take up to several hours.

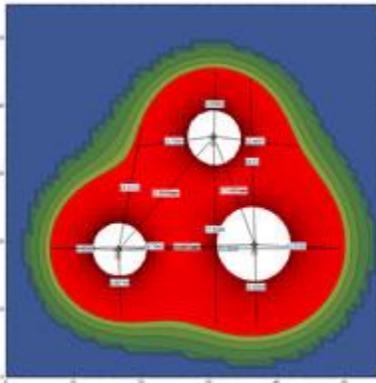
### **Step 3: Simulation**

Once the needles have been perfectly placed, the positions of the needles are measured with an ultrasound device and transferred to the NanoKnife® software and any additional external software applications. The area to be treated can still be adjusted on the computer using several parameters such as tension, pulse length and pulse number. If everything corresponds to the geometry of the organ and tumor (a safety edge around the tumor is always planned in), the NanoKnife® charges its capacitors.

#### **Step 4: Treatment**

Between each set of two needles, a potential difference is built up. This potential difference typically amounts to 3000 V between the needles. This means that Needle 1 carries +1500 V and Needle 2 -1500 V. The patient remains at 0 V. These voltage amounts may seem to be more deadly than gentle, but the amount of time for which they exist is measured in millionths of a second, making them safe and ensuring that they do not cause any negative side effects such as burns. For details on the way this technology functions and the theory of IRE see the article on IRE theory.

The number of needles can vary widely according to the challenges posed by the area to be treated. The computer of the NanoKnife® system takes over the appropriate type of control over the needles, depending on which area to be treated has been entered into the software. The treatment itself usually only takes seconds, but can last up to a maximum of a few minutes.



Various software applications developed at the Prostate Center based on data from many hundred evaluated MRI data sets and IRE protocols allow for superior planning precision.

#### **Step 5: Afterwards**

The needle insertion sites close instantaneously after the needles are withdrawn. The patient has no pain. Some people find the catheter unpleasant. The catheter can be removed after one to seven days. Small amounts of blood in the urine or seminal fluid are possible up to several weeks after the procedure because the body may need up to six months to evacuate the tissue destroyed by the IRE procedure's ablation.