PROTON THERAPY
A NEW CHANCE IN CANCER TREATMENT
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Façade of the RINECKER PROTON THERAPY CENTER in Munich
Proton Therapy for the treatment of cancer is gentle and effective. Since 2009 more than 3,500 patients have been treated with this method in our center. RPTC is the first sole clinical Proton Center in Europe – this longstanding experience makes us unique.

Our facility with four treatment spaces (gantries) is accessible for patients worldwide with either statutory or private health insurance. Due to the advantageous physical characteristics of the beam we can treat a wide range of solid tumors, specifically in the area of the head, spine and pelvis. With the use of anesthesia we can also treat cancer located within the range of respiratory organs. With regard to the gentle effectiveness the therapy is specifically useful with children. With the increasing technical progress, paired with more clinical expertise, the list of tumors that can be treated with Proton Therapy, will steadily increase. Within this range of tumors, we also irradiate prostate cancer. The treatment does not cause any pain – you simply do not recognize the irradiation.

The applied technology has proven to be successful around the globe. The treatment follows very strict protocols – with high precision through our scanning method – a technical system that had its first application in RPTC in 2009. In our center we have dedicated and experienced radiotherapists that will provide comprehensive information and will guide you through the entire therapy process.
The RINECKER PROTON THERAPY CENTER in Munich:
The first clinical proton therapy center in Europe
At present one in three people will be affected by cancer during their lifetime. With the decrease in cardiovascular diseases and increasing life expectancy, the incidence of cancer is growing.

Around half of malignant cancers are treated surgically and approx. 40% (50% in the USA) are treated with radiation. 27% of these are treated with radiation therapy alone, and 13% in combination with chemotherapy or surgery.

To date the most generally used standard is radiation with X-rays.

The maximum effect of X-rays occurs just under the skin, but diminishes on the way to the tumor with the result that the healthy tissue in front of the tumor is more strongly exposed to the radiation than the tumor itself.

Healthy tissue lying behind the tumor (e.g. spinal cord, optic nerves, parts of the brain) is unnecessarily exposed to the radiation which often causes side effects such as intestinal bleeding, skin irritation, pneumonia and subsequent arteriosclerosis. In addition, there is the risk of a follow-on tumor developing! Newer methods include Intensity Modulated Radiotherapy (IMRT) in which the tumor is irradiated from different directions, and Rapid Arc, in which irradiation takes place during a rotation around the patient. X-rays are also employed by the Cyberknife system in which digital imaging robot technology is combined with a high-precision radiation device in order to provide radio-surgical treatment. These methods are better at configuring the dose at the tumor site. However, healthy tissue is not spared. The physical problem of X-ray radiation remains unchanged since X-rays are a „shoot-through method“. 
NATURE AND EFFECTS OF PROTON BEAMS

Protons are accelerated to 60% of the speed of light and can be adjusted to penetrate up to 38 cm into the body. On their path to the tumor they only deposit small amounts of energy, but then release a large concentrated amount of energy into the tumor at the end of their trajectory. Hence, behind the tumor the patient is kept completely free of radiation!

The effect is therefore at its greatest in the tumor with the healthy tissue being essentially spared.

In contrast to the previously used X-rays, protons can be three-dimensionally directed onto the tumor with millimeter precision.

For the sake of completeness so-called heavy ions are also briefly mentioned as their mode of action is similar to that of protons. Carbon ions are mainly used in this regard. Although heavy ions exhibit less lateral scattering, through bursting of the heavy ions a radioactive „scattered radiation tail” occurs behind the tumor cancelling out the benefits of precision. The hope of sparing the healthy tissue behind the tumor is not fulfilled, as, in contrast to proton radiation, its greatest biological effect is located not in, but around the tumor: „The greater biological effect of heavy ions at the end of their path only occurs at lower doses, no longer within the tumor”.

Local dose curve when protons penetrate the body. The clear increase in effect at the end of the proton path (Bragg Peak) compared with X-rays substantiates the considerable advantages of protons in the treatment of deep tumors.

Through the variation in the proton beam energy and thereby the penetration depth during radiation treatment, a flat dose distribution covering the entire tumor area is produced (Bragg Plateau). The massive reduction in harmful radiation in the healthy tissue at the same tumor dose is evident. At the same time the figure clearly shows the reduction of the dose already within the tumor which is characteristic of X-rays.
CLINICAL EXPERIENCE WITH PROTONS

The RPTC in Munich is the first center in Europe that has been set up exclusively for the treatment of patients and is not a modified research facility. Its physical properties allow a comprehensive range of radiation therapies for tumors located up to 38 cm deep in the body. Other institutions, such as the Hahn-Meitner Institute in Berlin, only treat tumors that can be reached with a shallow beam penetration depth - in the eyes for example - due to the lower energy of 72 MeV.

Centers which have to date been able to gather clinical experience are located at Loma Linda University near Los Angeles, the Massachusetts General Hospital of Harvard University in Boston, the M.D. Anderson Cancer Center in Houston and the Paul-Scherrer Institute in Switzerland, whereby the latter only has a small capacity and mainly treats patients as a part of studies investigating new areas of application of proton therapy.

Since the start of proton therapy in the late 1960s, around 70,000 patients have been treated throughout the world in what by now are 30 large-scale or experimental proton therapy centers.

The RINECKER PROTON THERAPY CENTER started treating patients in March 2009. The patients benefit from the fact that clinical experience with conventional X-ray radiation can be adopted for proton radiation on a one-to-one basis. The biological effect of both types of radiation is essentially the same: the splitting of electrons from an atom, which via intermediate stages leads to cell-DNA damage and death the next time the cell divides.
THE CLINICAL SUPERIORITY OF PROTON THERAPY

**Increased chances of recovery.**
By sparing the healthy tissue the dose can be increased in the tumor. Hence, the chances of recovery are considerably increased in the absence of metastases.

**Minimised side effects.**
The much lower exposure to radiation in healthy tissue considerably reduces side effects so that proton radiation therapy is tolerated comparatively well. The risk of a secondary tumor resulting from the radiation also decreases.

As opposed to X-ray therapy, the treatment complies with all the statutory requirements of the Radiation Protection Order of 2001!

**Increased treatment options.**
Because of the absence of radiation behind the tumor, high-dose treatment is possible for forms of cancer in which radiation therapy was previously too risky due to surrounding sensitive organs (e.g. spinal cord, brain stem, liver or lungs). Radiotherapy of eye tumors in which the optic nerve, the cornea or adjacent brain tissue is left undamaged has become standard. According to international opinion children should be treated with protons.
TREATABLE CANCERS

IN PRINCIPLE, DUE TO THE PHYSICAL AND BIOLOGICAL PROPERTIES OF PROTONS, ALL TUMORS THAT WERE PREVIOUSLY TREATED WITH X-RAYS CAN BE TREATED WITH PROTONS.

Children are given priority to proton therapy: The life-span incidence of secondary tumors caused by therapeutic radiation can be significantly reduced. Furthermore, radiation damage to growing organs, such as growth plates and other vital organs can be avoided or reduced to such a level that their function is preserved (particularly in the brain, eyes, ears and base of the skull).

Tumors in the head/neck areas for example are especially suitable. After X-ray therapy these patients suffer from a persistent dry mouth due to the almost unavoidable irradiation of saliva glands. This results in problems when speaking and eating and incurs follow-up treatment costs.

Two different perspectives of an X-ray treatment plan for a relapsing nasopharyngeal tumor with radiation from several directions are shown. Conventional radiotherapy with X-rays results in an unacceptable exposure of the healthy surroundings. In this case the saliva glands are severely damaged.
Compared with the X-ray plan (on the left) the illustrated proton therapy plan shows the superiority of the three-dimensional targetability of our method. Exposure of the tissue surrounding the tumor is minimised so that the tumor can be treated with higher doses, increasing the chance of recovery of the patient.

These side effects are avoided by proton therapy.

Other very important indications are tumors of the brain and the base of the skull with highly radiation-sensitive tissue and organs in close proximity.

Protons

Dose ranges

- 100 %
- 95–100 %
- 90–95 %
- 80–90 %
- 60–80 %
- 40–60 %
- 20–40 %
- 10–20 %

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In the case of tumors in the lungs the exposure to radiation of healthy parts of the lungs and adjacent organs can be kept at a minimum - as with liver tumors. At present comparative studies are being conducted in the USA which indicate that proton radiation treatment is better even than surgery in bronchial carcinomas (lung cancer).

In the abdomen and pelvis, e.g. in prostate cancer, the side effects of proton therapy are reduced to 1/5 to 1/3 compared with X-ray therapy. This is of decisive importance to the quality of life and well-being of the patients.

Three different perspectives of an X-ray treatment plan for a patient with a lung tumor are shown. Irradiation takes place from several directions. Both lungs are strongly exposed to the radiation.
Protons

In certain cases local relapses and metastases in all parts of the body can be completely or partially eliminated only by proton therapy while preserving vital organ functions. Tumors which cannot be treated with radiation are mobile tumors, such as tumors of the upper colon and leukemias.

Only a proton therapy expert can determine the need for proton therapy. In Germany prior clinical experience is necessary for becoming a certified specialist.

Dose ranges

- 100 %
- 95–100 %
- 90–95 %
- 80–90 %
- 60–80 %
- 40–60 %
- 20–40 %
- 10–20 %

Compared with the X-ray plan (on the left) the proton therapy plan shows the superiority of the three-dimensional targetability of our method. Adjusting the penetration depth of the proton beams allows the heart and the healthy lung to be spared to a large extent.
Treatment room with targeting device [gantry]:
One of four identical rooms at the
RINECKER PROTON THERAPY CENTER in Munich
**Generation of the proton beam**

Protons are obtained from hydrogen gas. The volume of gas required for treatment is smaller than a champagne bubble. In the particle accelerator, the cyclotron, electromagnetic fields accelerate the protons to 60% of the speed of light (180,000 km per second). Magnetic fields then direct them into a vacuum tube and to the gantry in the treatment room.

**Fixed-beam treatment room**

In addition to the four treatment rooms with gantries the RPTC also has a fixed-beam treatment room which is used for the treatment of tumors of the eyes, the brain and the base of the skull. In contrast to the gantries this uses a horizontal beam which only radiates in one direction. For this treatment method the patient sits on a rotating chair on which he/she is adjusted with positioning aids.

Floor plan of the RPTC, ground floor, treatment section, on the left is the radiation source, the cyclotron. Beam preparation in the curve. The focusing and bending magnets in red. 4 gantries, 1 fixed-beam treatment room for eyes and the head in the center. Linking 5 treatment rooms to the source of radiation utilizes continuous proton beam production to the full in terms of time, without putting individual radiation therapy under time constraints. Building length: 110 m.
Irradiation in the gantry
The “gantry”, the aiming device, weighs 150 tons, has a diameter of 11 meters and can be rotated 360° around the patient within one minute with millimeter precision. The patient can therefore be irradiated from medically optimized directions. In contrast to X-ray radiation therapy, treatment here is carried out with high accuracy in all three spatial dimensions, i.e. the beam can be directed with extreme precision with deviations of less than 1 mm.

During each treatment session the patient has to be positioned in exactly the same way and is immobilized on a contour bed prepared especially for him/her. An X-ray assisted precision targeting system adjusts the patient until the marked tumor is exactly in the target area of the beam, which emerges from the “nozzle” positioned directly in front of the patient.

For proton radiation the RPTC uses a special “Voxel-to-Voxel-Modulated” scanning method - the most modern form of proton therapy - to raster scan the tumor with pin-point precision using up to 10,000 target points in the tumor. The beam penetration depth is controlled by the variable radiation energy. This is the only method that allows the therapy dose, i.e. the maximum dose, to be strictly limited to the tumor.
Treatment is equally available to patients with compulsory as well as private health insurance and is generally carried out on an out-patient basis.

If you are recommended for radiation therapy with protons, in all cases a comparative dose calculation for X-ray radiation will also be carried out in order to confirm the benefits of the proton method.

**Diagnosis and target planning**

During the first consultation your medical history, indication regarding proton therapy, its side effects and the course of your treatment will be discussed in detail. The first two to four days are reserved for diagnostics and treatment planning. During the staging examination your entire body will be screened for signs of tumors and metastases. This will be done by whole-body magnetic resonance tomography (MRT), sometimes also in combination with PET-CT (positron emission tomography), both of which are entirely painless. In individual cases further examinations such as endoscopy, sonography (ultrasound) or angiography are necessary. For the purposes of target planning very-high-resolution computer tomography (CT) is carried out. All the necessary equipment is available at the RPTC. The image material from the staging examinations provide the radiology team with impressively precise findings in high three-dimensional resolution for the target planning which will then be discussed with you at the second consultation.
The specialists’ tumor board
As oncology is spread over many different specialists fields, it is self-evident that the relevant specialists be integrated into the planning of treatment. For this purpose the center has a tumor board, the members of which are specialists in radiotherapy, radio-diagnostic, surgery, oncology, internal medicine and pathology. The tumor board examines each treatment decision and can be involved in the target planning. Depending on the case, further specialists are also included along with the referring physician if possible.
The radiotherapy
The number of radiotherapy appointments depends on the nature and size of the tumor. A number of min 5 up to max 30 sessions (on average 18 sessions) can be expected (Mondays to Saturdays, one per day). The procedure takes approximately 15 to 20 minutes of which the actual radiation only lasts about 60 seconds and is completely painless. Normally no more than 30 - 45 minutes, including preparation time, are required for each treatment session.

In some cases diagnostic measures and radiation therapy are carried out under a brief light anesthetic - for example with children who often find it difficult to keep still.

In the case of tumors on the lung and liver, breathing movements play an important role. Under such circumstances the lungs undergo controlled inflation with oxygen during the application of a brief anesthesia, thereby enabling precise irradiation of the tumor. No oxygen deficiency occurs.

Follow-up examination
You will be informed about any stipulated or recommended follow-up examinations during your discharge consultation. At the same time letters detailing your postradiation care will be sent to the doctors named by you.
In principle almost all methods of treating tumors can be combined with each other. For combining proton therapy with surgery, the CHIRURGISCHE KLINIKUM MÜNCHEN SÜD (www.artemed.de/ckms/de/) specializing in abdominal surgery, thoracic surgery, vascular surgery, cardiac surgery, trauma surgery, disc and spinal surgery and the breast center offering oncological and plastic surgery is available.

In-patient or out-patient chemotherapy combined with proton radiation therapy is carried out at the treatment center of the DR MÜLLER INTERNAL CLINIC (www.muellerklinik.de) which specializes in the gastrointestinal tract, liver, pancreas, heart and lungs. Where there is a medical need, beds are available at these clinics for patients who are weak or in pain. These facilities are in the immediate vicinity of the radiotherapy units.
Monte Carlo Simulation.  
Computer-based target planning improved by complex new calculation methods allows radiation targeting better adapted to the characteristics of the surrounding tissue.

Computation-based prediction of impairment of surrounding tissue.  
New computation methods will make it possible to predict the probability of radiation injuries in the surrounding tissue. This will be used in the RPTC to verify the protection of healthy tissue specifically with proton technology.

Liquid Biopsy – The automated analysis of genetic material has become effective (and cheap), so that it will be possible to monitor the irradiation progress from the analysis of venous blood. This will be used specifically for the supervision of fast radiation treatments.

Conservation of rectum with prostate cancer.
We recommend the use of so called “spacers”, applied by injection, which will later on dissolve without residues. They will push the rectum almost entirely out of the radiation zone.

Better cure with assessment of lymph nodes of prostate cancer.
A prostate carcinoma usually spreads along a lymph node pathway upwards. To remove those nodes, surgery is a less practicable option, while it is dangerous to treat this with conventional x-rays because of damage to the intestine. At the RPTC these lymph nodes are diagnosed as a matter of routine (MR-scan, PET CT) and strictly targeted with protons without harm to the intestine.

Prostate radiation within one week.
Experience in the international community shows that shortening the radiation treatment (and shortening the recovery phases for the tumor) leads to equal if not better results. This “hypofractionation” is most advantageous with protons, due to the protection of surrounding tissue. Early stage cases can, under certain circumstances, be treated entirely within one week.

Stabilized breast cancer radiation.
A major problem after breast cancer surgery is the unavoidable exposure of lung and coronary vessels by the application of conventional x-rays. With protons however, these areas can be spared. This enormous precision requirement is difficult to accomplish with the movable breast. We use a specifically adapted stabilizer, which through a mild vacuum fixing the mamma guarantees a precise targeting for the radiation.
Outpatients can be accommodated at the directly adjoining GÄSTEHAUS AM RPTC (GUESTHOUSE AT THE RPTC). With a 3 to 4-star rating it offers single and twin rooms as well as some suites, a restaurant and a bar, as well as a fitness room, play area and children’s playroom.

The bright and friendly ambiance, the attentive staff and the beautiful location directly at the river Isar help to ensure that your stay will be as pleasant as possible.

For further information visit our website or ask for our brochure.

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Internet: www.gh-rptc.de
LOCATION AND ARRIVAL

Main entrance
Franz-von-Rinecker-Straße

Entrance for patients unable to walk
Schäftlarnstraße 133

Underground station
Thalkirchen (U3)
Arrival:

From Munich airport (45 min.)
Take the S-Bahn (local train) S1 or S8 to Marienplatz, change to the U3 in the direction of Fürstenried West, leave at Thalkirchen station.

You will find the RPTC 500m along Schäftlarnstrasse on your right.

From Munich main railway station (15 min.)
Take any S-Bahn (local train) in the direction of Marienplatz, change to the U3 in the direction of Fürstenried West, leave at Thalkirchen station.

You will find the RPTC 500m along Schäftlarnstrasse on your right.

By car
On the "Mittlerer Ring" (central ring road) follow the signs for "Zoo" and turn off at Schäftlarnstrasse.

After approx. 700 m you will see the RPTC on the left.

Parking
There is limited parking available on Schäftlarnstrasse and at the RPTC guesthouse garage.

Your contact

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