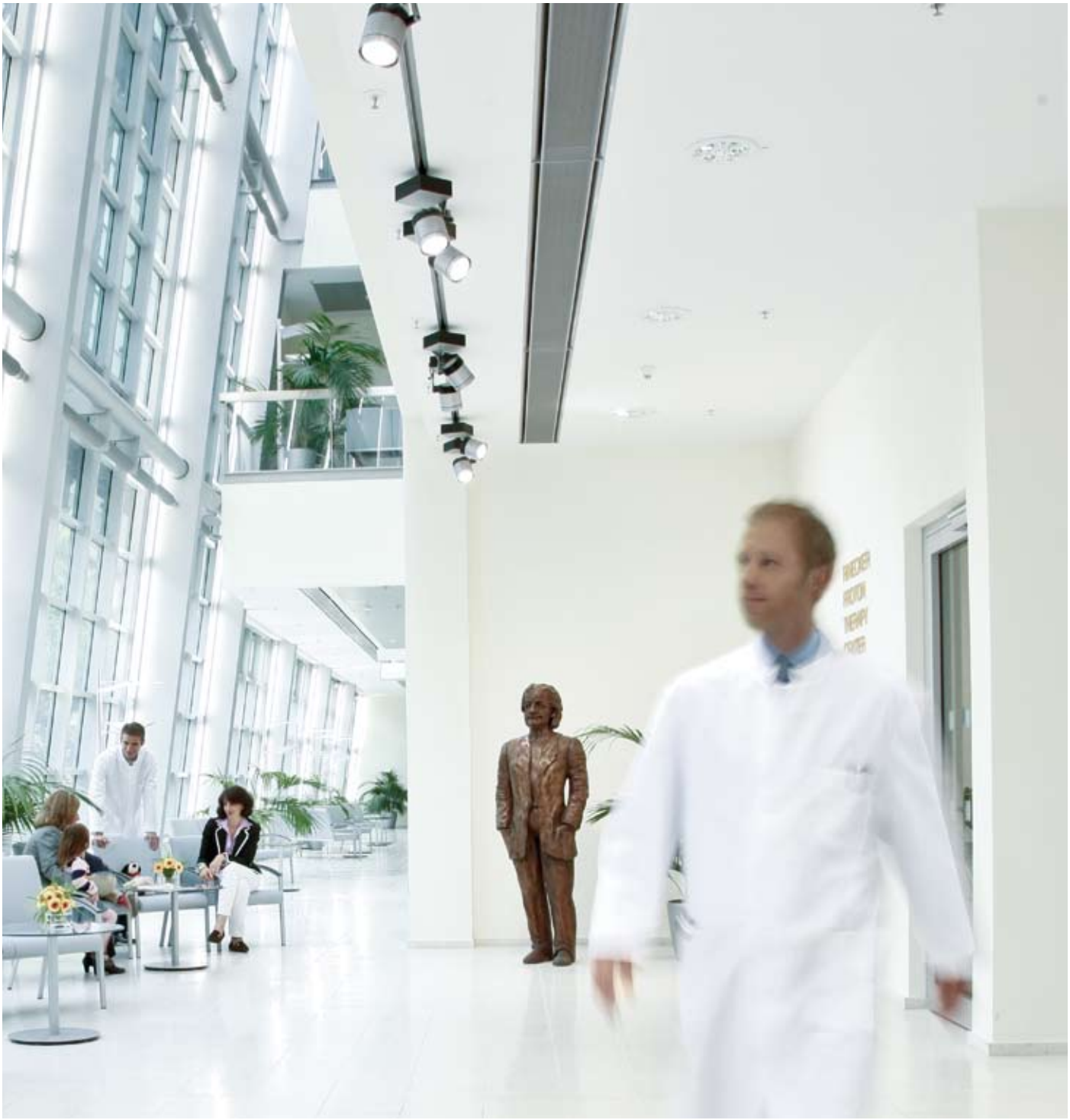
RINECKER
PROTON
THERAPY
CENTER

PROTON THERAPY
A NEW CHANCE IN CANCER TREATMENT

CONTENTS



Façade of the RINECKER PROTON THERAPY CENTER in Munich

A NEW CHANCE IN CANCER TREATMENT

The RPTC in Munich was established at the initiative of Munich physician Dr Hans Rinecker PhD. It is the first European, clinically-operated proton radiation center for the treatment of cancer patients. It began admitting patients for radiation therapy in March 2009.

With five treatment rooms, the center is designed for the treatment of over 4000 patients per year, and is available to both patients with compulsory and private health insurance. This outstanding building features a light flooded architecture. Its location on the River Isar allows patients to enjoy the extremely beautiful surrounding and positive ambiance.

Dr Hans Rinecker PhD.

The RINECKER PROTON THERAPY CENTER in Munich:
The first clinical proton therapy center in Europe

NATURE AND EFFECTS OF X-RAY BEAMS

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.

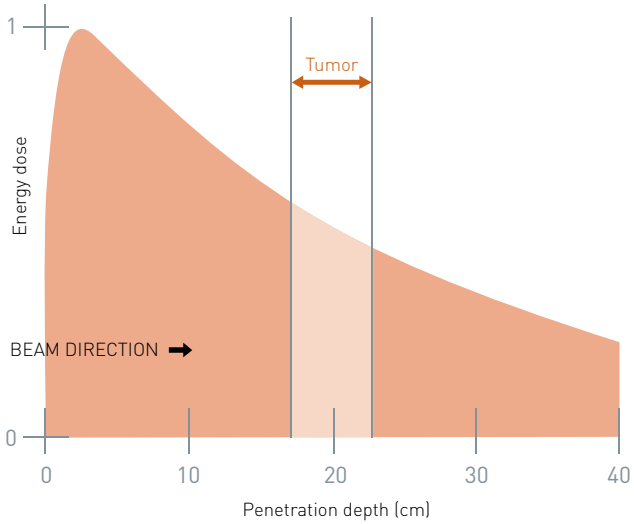
Around half of malignant cancers are treated surgically and approx. 40% (50% in the USA) are treated with radiation. 27% of these are treated with radiation therapy alone, and 13% in combination with chemotherapy or surgery.

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.

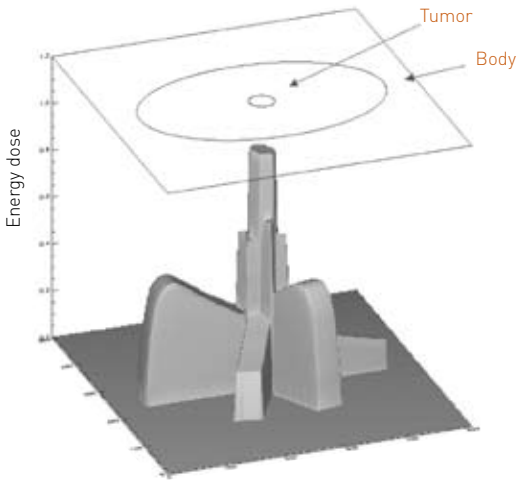
Healthy tissue lying behind the tumor (e.g. spinal cord, optic nerves, parts of the brain) is unnecessarily exposed to the radiation which often causes side effects such as intestinal bleeding, skin irritation, pneumonia and subsequent arteriosclerosis. In addition, there is the risk of a follow-on tumor 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".

X-RAYS (linear accelerator 15 MV)



Local dose curve when X-rays penetrate the body

X-RAYS



Cross-section through the body

X-ray irradiation of a model tumor with triple overlapping (3 portals)

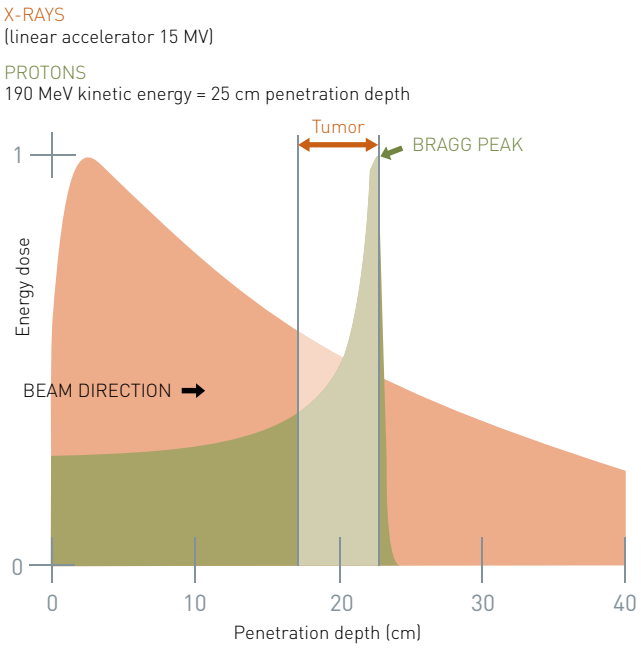
NATURE AND EFFECTS OF PROTON BEAMS

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!

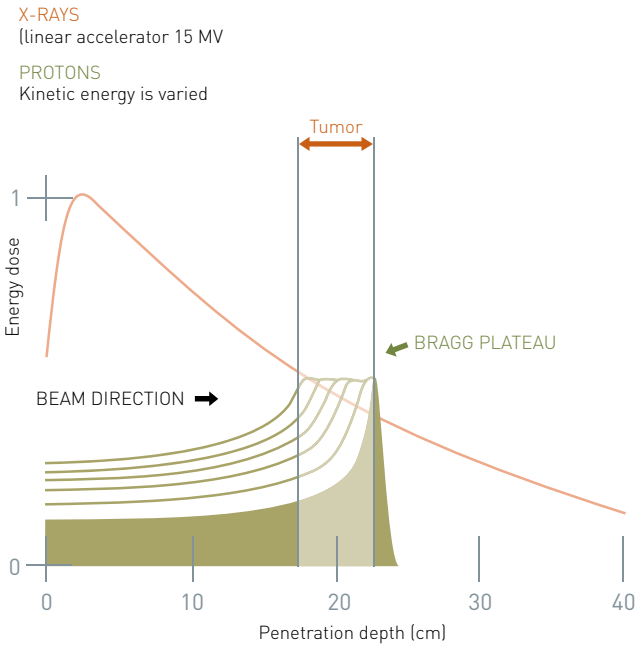
The effect is therefore at its greatest in the tumor with the healthy tissue being essentially spared.

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 60,000 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.

Foyer of the RINECKER PROTON THERAPY CENTER

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.

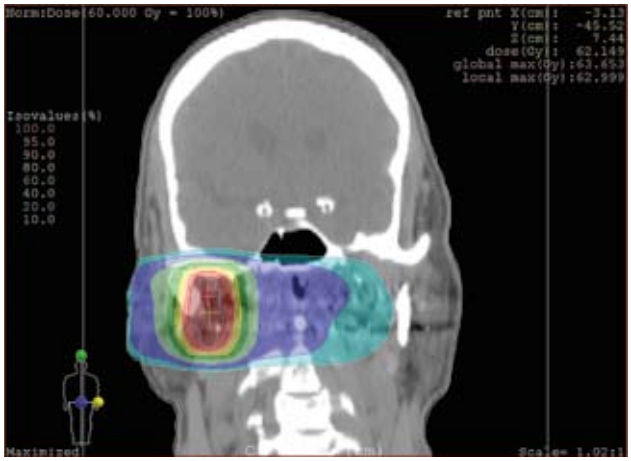
TREATABLE CANCERS

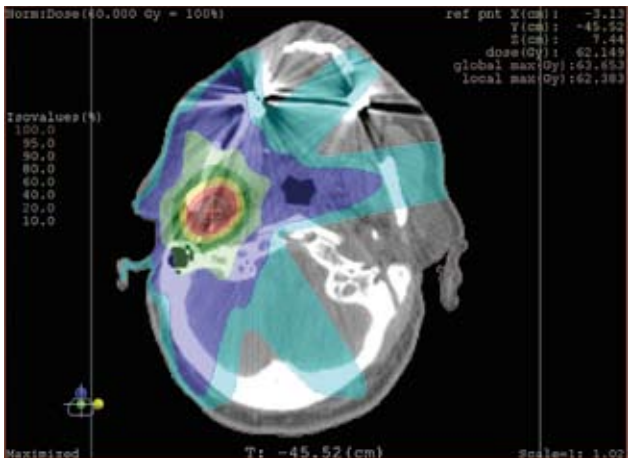
IN PRINCIPLE, DUE TO THE PHYSICAL AND BIOLOGICAL PROPERTIES OF PROTONS, ALL TUMORS THAT WERE PREVIOUSLY TREATED WITH X-RAYS CAN BE TREATED WITH PROTONS.

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.

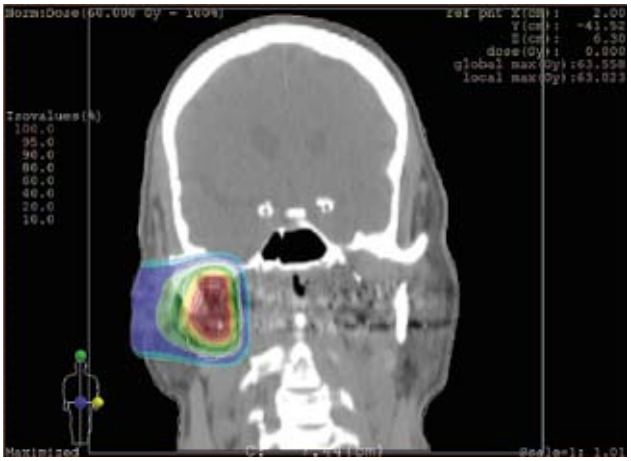
X-rays





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.

Protons



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.

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.

Dose ranges

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

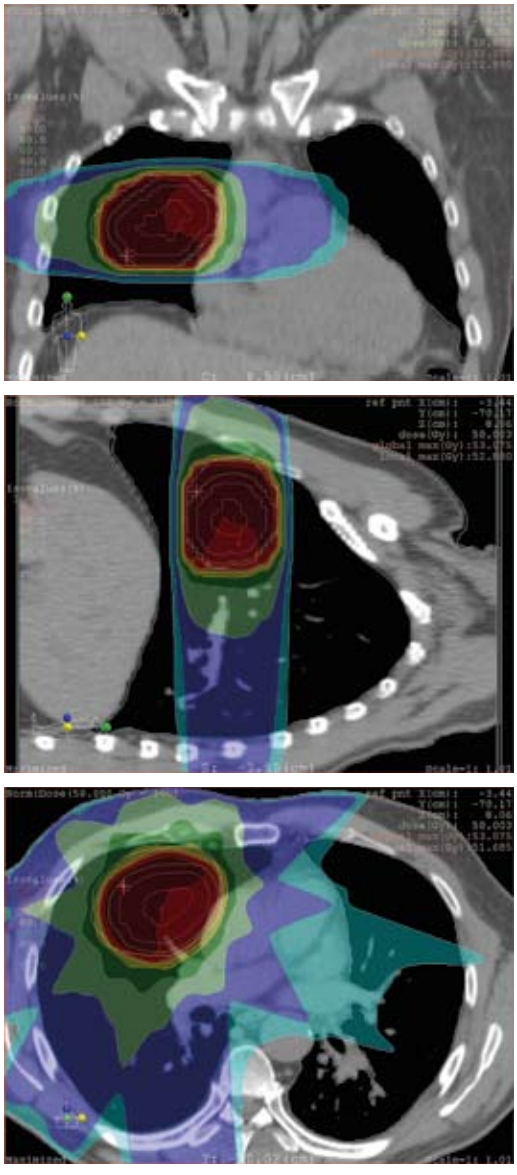
TREATABLE CANCERS

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.

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).

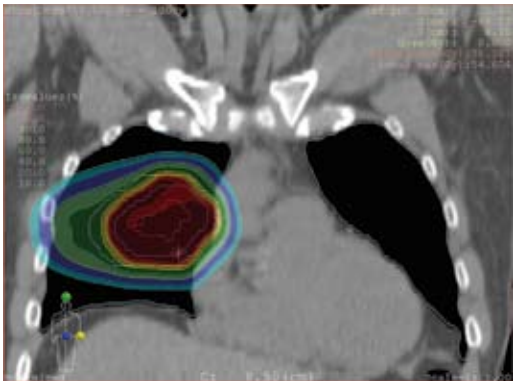
In the abdomen and pelvis, e.g. in prostate cancer, the side effects of proton therapy are reduced to 1/5 to 1/3 compared with X-ray therapy. This is of decisive importance to the quality of life and well-being of the patients.

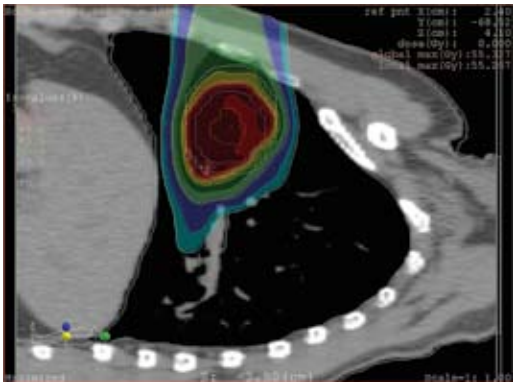
X-rays

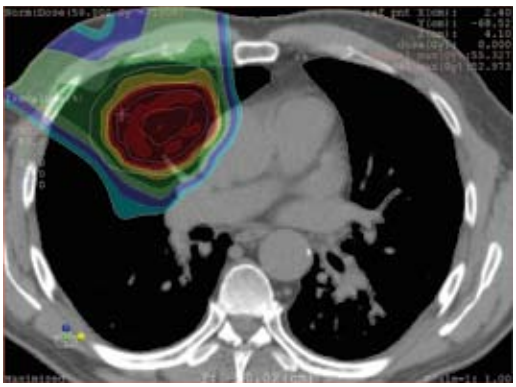


Three different perspectives of an X-ray treatment plan for a patient with a lung tumor are shown. Irradiation takes place from several directions. Both lungs are strongly exposed to the radiation.

Protons







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.

Dose ranges

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

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.

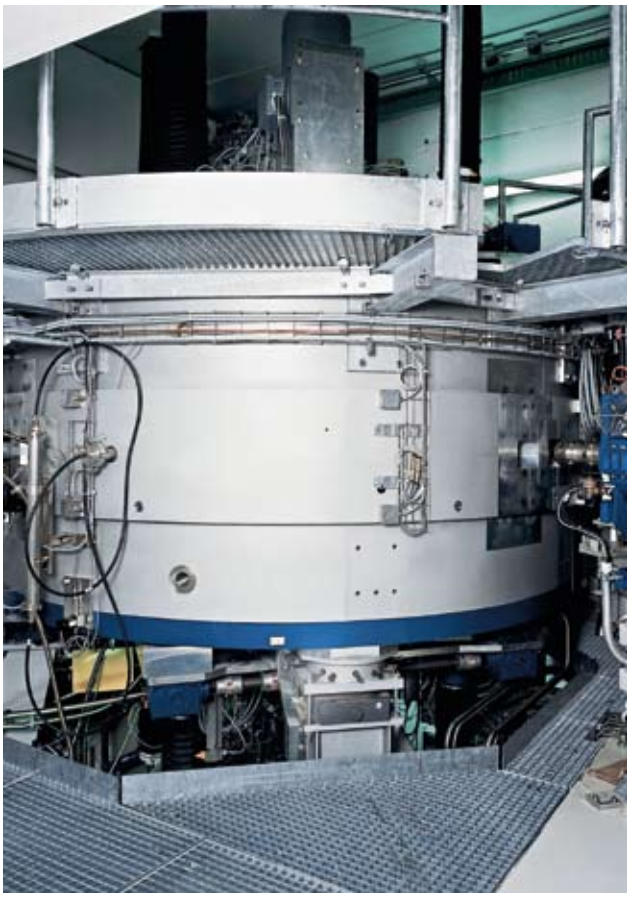
Treatment room with targeting device (gantry):
One of four identical rooms at the
RINECKER PROTON THERAPY CENTER in Munich

Foto: Karsten Thormaehlen

GENERATION AND TARGETING OF THE BEAM

Generation of the proton beam

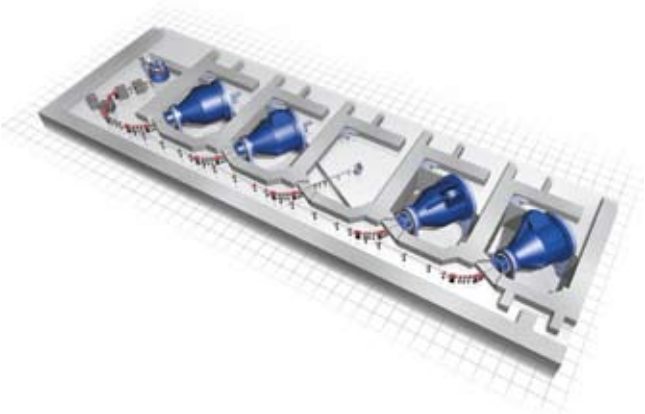
Protons are obtained from hydrogen gas. The volume of gas required for treatment is smaller than a champagne bubble. In the particle accelerator, the cyclotron, electromagnetic fields accelerate the protons to 60% of the speed of light (180,000 km per second). Magnetic fields then direct them into a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



Radiation source (superconducting cyclotron; 250 MeV protons) – Installation at the RPTC. To the right of the center of the picture the tube from which the radiation emerges can be seen, which then disappears into the complex radiation guiding structure.

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.

The patient tables can be moved in all directions. The patient lies on a contoured mattress specially adapted to him/her. In this case the pyramid-shaped nozzle is set for irradiation from above. Extendable wings are integrated into the sides and contain digital X-ray screens checking the precise positioning of the patient. As part of the gantry the nozzle can rotate 360° around the patient.

YOUR ADMISSION AND TREATMENT AT THE RPTC

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.

PET-CT

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-diagnostics, 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. On average 18 sessions (Mondays to Saturdays, one per day) can be expected. 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.

COMBINATION THERAPIES

In principle almost all methods of treating tumors can be combined with each other. For combining proton therapy with surgery, the DR RINECKER SURGICAL CLINIC (www.rinecker.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.

THE GUESTHOUSE

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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Taking care of your every need:
The GÄSTEHAUS AM RPTC

INTERNATIONAL PATIENT SERVICE

PRO HEALTH COMPLETE CARE SERVICE GMBH (PH-CCS) is at your disposal if you have any other wishes with regard to your accommodation and/or require help in arranging your stay. This is a company associated with ProHealth AG, and in cooperation with the RINECKER PROTON THERAPY CENTER (RPTC) it offers an exclusive care service.

If you so wish, PH-CCS can assist you right from the start in the planning of your stay as well as during it. In addition to organizing your in-bound journey, visa formalities, accommodation, airport transfer and translation of your medical records, PH-CCS also offers a limousine and rental car service, interpreting services, secretarial services, personal trainer, childcare and leisure activities. Whichever service you use, PRO HEALTH COMPLETE CARE SERVICE guarantees that you and those accompanying you will be made as comfortable as possible and have nothing to worry about.

Ursula Friedsam
Managing Director PH-CCS

PROHEALTH
COMPLETE
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RINECKER

International Patient Services
RINECKER PROTON THERAPY CENTER
DR. RINECKER SURGICAL CLINIC

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

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Guesthouse at the RPTC
Franz-von-Rinecker-Straße

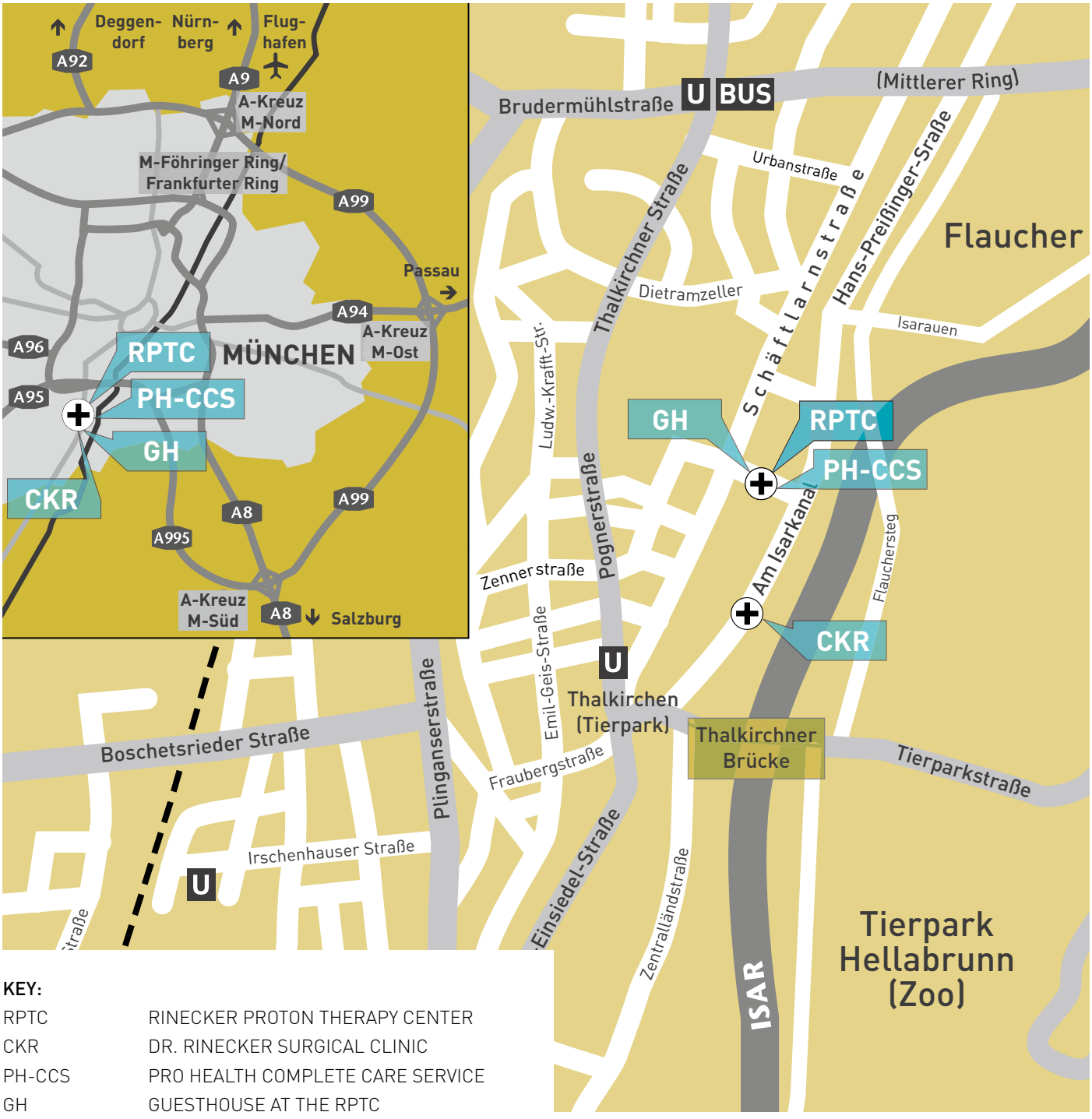
Postal address:
Schäftlarnstraße 135
81371 München

LOCATION AND ARRIVAL

Main entrance
Franz-von-Rinecker-Straße

Entrance for patients unable to walk
Schäftlarnstraße 133

Underground station
Thalkirchen (U3)



KEY:

RPTC	RINECKER PROTON THERAPY CENTER
CKR	DR. RINECKER SURGICAL CLINIC
PH-CCS	PRO HEALTH COMPLETE CARE SERVICE
GH	GUESTHOUSE AT THE RPTC

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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Fax: +49 (0) 89 66068-100
E-Mail: patient@rptc.de
Internet: www.rptc.de

Treatment at the RPTC today:
You can find our monthly reports on our home page under "Current news"

For more detailed information about proton therapy we recommend the book:

'Proton Therapy'
Neue Chance bei Krebs
(A New chance in cancer treatment)
Dr Hans Rinecker
Herbig Verlag, ISBN 3-7766-2422-1
(available in German only)

RINECKER
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