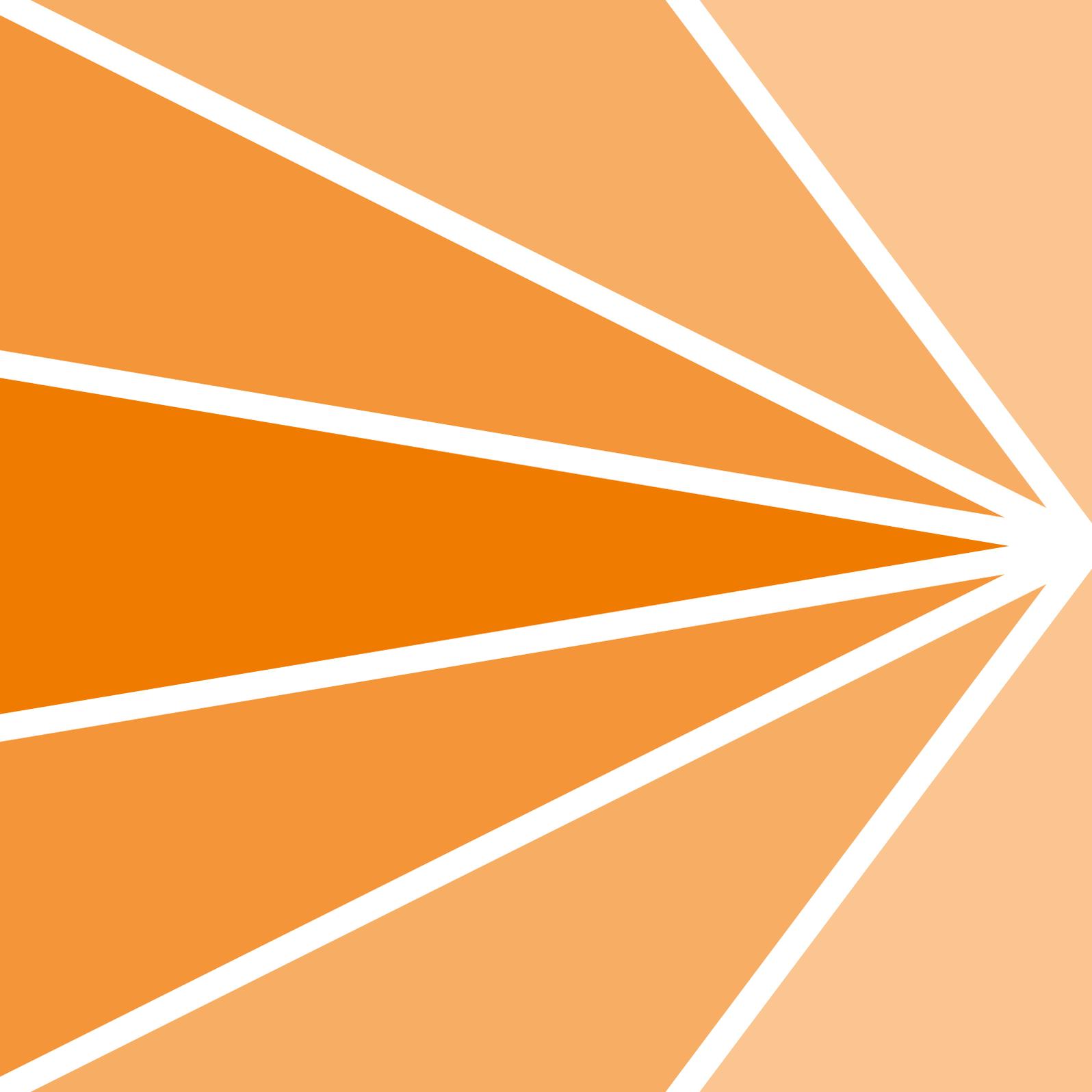


# First CyberKnife® in south western Germany

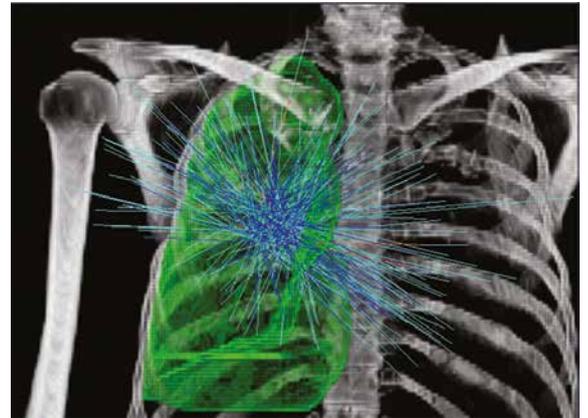


 **RadioChirurgicum**  
CyberKnife® Südwest



# Content

|   |         |
|---|---------|
| Foreword                                | page 4  |
| The modern Radiosurgery                 | page 5  |
| The Cyberknife®-System                  | page 6  |
| New treatment option for tumor patients | page 8  |
| Innovative treatment-planning           | page 9  |
| Course of treatment                     | page 10 |
| Indications at glance                   | page 13 |
| Members of the medical team             | page 14 |
| Partners                                | page 16 |
| Who pays for the CyberKnife® treatment? | page 18 |
| Your point of Contact                   | page 19 |
| Driving Directions                      | page 20 |



# Welcome to the RadioChirurgicum in Göppingen, Germany!

Dear patients, modern cancer and tumor therapy has changed and evolved rapidly over the last 20 years. Today a wide variety of treatment modalities individually tailored for different situations can be offered. Using the CyberKnife® System, an innovative, highly effective technology with low side effects is now available for local tumor treatment that significantly improves the treatment for many types of cancers and benign tumors. With the CyberKnife® tumors especially in the brain, lung, liver, pancreas, spine, kidney, adrenal gland, prostate as well as in bones can be treated non-invasively with high precision and without any pain.

Since summer 2013 there is a treatment center "RadioChirurgicum" CyberKnife® Southwest in Göppingen (near Stuttgart) available, offering this new form of cancer therapy, which is unique in the South-West region of Germany. In the RadioChirurgicum different experts in the field of Radio-

oncology and Neurosurgery have joined together with external cooperation partners, e.g. of the medical physics division, to become a supraregional, unique competence network for radiosurgery.

Concentrated competence to the benefit of the patient in the RadioChirurgicum different experts in the field of Radiooncology and Neurosurgery have joined together with external cooperation partners, e.g. of the medical physics division, to become a nationwide, unique competence network for radiosurgery. The idea behind the

center is to combine all experiences of different departments to offer our patients highly personalized consultancy services, tailored and adapted specifically to their needs. That makes it possible to select the therapy which is best suited to your individual disease situation. We would be pleased to inform you in a personal consultation about adequate treatment and chances, which are offered by this new form of radiosurgery in your individual health situation.

Your RadioChirurgicum team



# The modern Radiosurgery

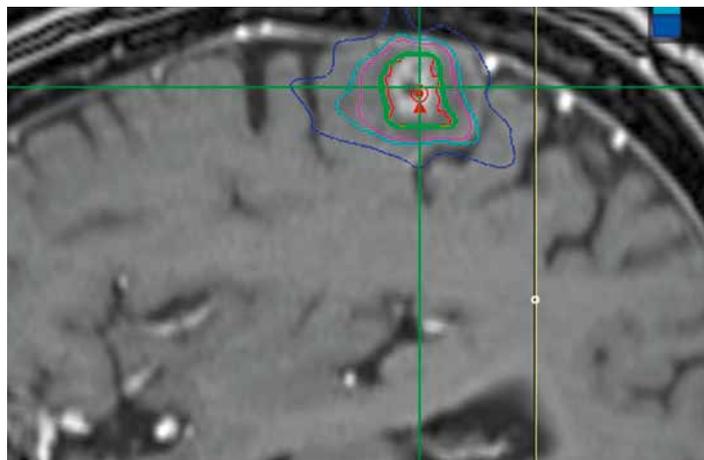
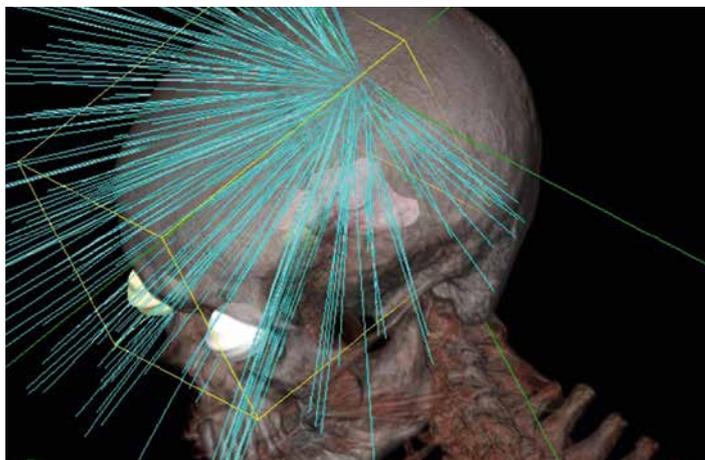
## Concentrating and focusing on the most important: The Tumor

The modern cancer therapy covers a multitude of various methods of treatment. In addition to the surgical removal there are many forms of medical tumor therapy, as well as the treatment of tumors with high energy (ionizing) radiation. The selection of the appropriate method differs from patient to patient, taking into account not only the disease but also the attending circumstances as well as the living conditions of the individual patient to ensure the ideal therapy.

Radiosurgery is a special kind of radiotherapy which requires complex technical resources. Many rays from different directions intersect directly in the tumor, which has been exactly localized by means different techniques including multiple imaging modalities in combination with dedicated algorithms for tumor

gating and tracking By using this approach, a high amount of dose can be given into tumor area while the unbundled single rays are rather harmless for the surrounding healthy tissue.

Because of the fact that the high dose area is limited to the intersection of more than 100 single up to 200 single beams, it is possible to irradiate the tumor within sub millimeter precision and a steep dose fall off to the surrounding healthy tissue. The application of highly focused radiation doses allows the delivery of very high dose which are able to kill the tumor cells persistently in about 90% of the cases, without giving harm to the surrounding healthy tissue.



The delineated tumor in the right image is treated from many different directions to provide a steep dose fall off to the periphery (left image). Thus, the required high radiation dose is achieved only in the region of the tumor by sparing the surrounding healthy tissue.

## The Cyberknife®-System

It is a perfect combination of robotics and high-precision radiotherapy

The CyberKnife® system consists of a radiation device, called a linear accelerator which is mounted on the arm of an industrial robot which moves around the patient during the treatment, controlled by an imaging and steering software without touching the patient.

In contrary to other stereotactic devices e.g. linear accelerators, the CyberKnife® uses a combination of a precise image guidance system on one hand and a robotic steered linear accelerator on the other: Both patient- and tumor movements are recorded in real time and the position of the treatment beam is immediately adjusted to the correct position.

The patient can lie comfortably on his back on the treatment table. The individual radiation beams which are delivered from many different directions are directed on the tumor with a submillimeter accuracy. This way the required radiation dose can

be delivered with a high precision from several sides keeping each single dose to a minimum but reaching the required high radiation dosage to destroy the tumor cells only within the tumor where all beams intersect. Since the individual beams have only a very low radiation dosage they are harmless to healthy tissue.

The treatment with the CyberKnife® can therefore offer an alternative for localized benign and malignant tumors and Oligo-metastases, but also serve as an adjunct to surgery, e.g. when tumors could not be removed completely.

The CyberKnife® demonstrates an impressive precision, which minimizes the risk of geographic misses and reduced the radiation dose to healthy tissue and organs significantly .





The robot positions the radiation device at pre-programmed positions on spherical orbits around the patient and irradiates the tumor from many different positions one after another.

# New treatment option for tumor patients

Alternatively or in addition to surgery

- 1 Greater range of possible treatments**

The flexibility of the robot arm allows to treat tumors in almost every specific region of the body. This method can also be used to treat residual tumor after incomplete surgery. Moreover the CyberKnife® allows the treatment of complex tumors, which are not operable due to their location.
- 2 Treatment in comfortable supine position**

The treatment takes place in a comfortable supine position with no need to limit the respiration of the patient to minimize the tumor movement. Due to the extraordinarily tracking capabilities of the CyberKnife®-system there is no need for a stabilizing frame at the skull of the patient.
- 3 Only a few treatment sessions**

A treatment with the CyberKnife®-System consists of one to maximal five treatment sessions lasting about one hour. As a result it is possible to complete the treatment within one to five days - in contrast to the conventional radiotherapy, which usually take several weeks.
- 4 Pain-free treatment**

The system provides a painless, non-invasive, ambulatory treatment - without long lasting recovery. After the treatment an immediate return to everyday activities is usually possible.



The whole treatment takes place in a comfortable supine position with usually no need for limiting fixations.

# Innovative treatment-planning

State of the art planning methods preserve the healthy tissue

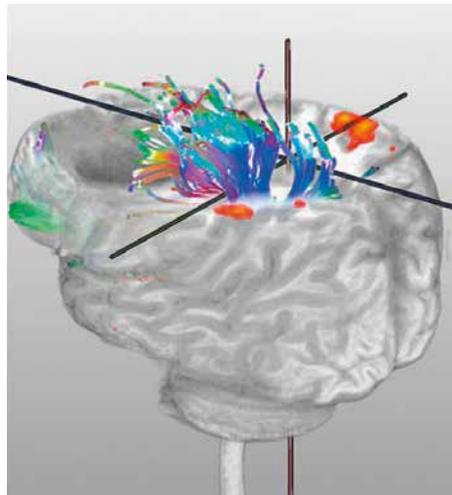
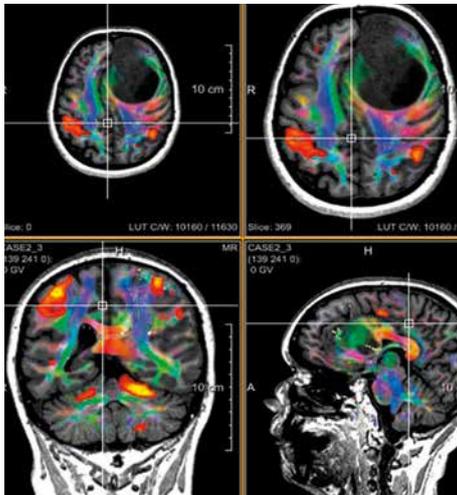
In addition to the established methods, the medical team of the RadioChirurgicum has developed an innovative planning procedure which enables a more specific irradiation of the tumors and while maximally sparing the surrounding healthy tissue:

- i-ART® “intraoperative image based advanced radiosurgical targeting”
- f-ART® “functional imaging based advanced radiosurgical targeting”

The i-ART® method is for example applied at radiosurgical treatments after incomplete removal of brain tumors and uses intra-operative neuronavigation photos and images that were made by the neurosurgeon during surgery according to an established

protocol in addition to the planning MRI. This ensures that parts of the tumor that would otherwise not be seen in the planning MRI, are clearly located and included in the target area of irradiation.

The f-ART® method is used for the irradiation of brain tumors in highly sensitive areas of the brain, in the vicinity of brain pathways and functional areas such as language or motor centers. The radiosurgical treatment is planned on the basis of MRI images with specific sequences in which the brain pathways and brain function areas can be shown. So this most sensitive areas of the brain can be spared.



With State of the art magnetic resonance imaging methods and evaluation programs (NeuroQLab, Mevis Fraunhofer Bremen), the brain pathways and the functional areas of the brain are illustrated.

# Course of treatment in the RadioChirurgicum

## 1. Initial interview – consultation

After an initial assessment of all medical findings a decision is made whether a CyberKnife® treatment may represent the best possible treatment for you in your particular case. If so, we invite you for a personal consultation.

Due to the interdisciplinary structure of the RadioChirurgicum team we can explain to you in this first interview all potential treatment options in detail. If radiosurgery is the best treatment option for you, we will explain in detail the

benefits and possible risks as well as each step of the CyberKnife® treatment.



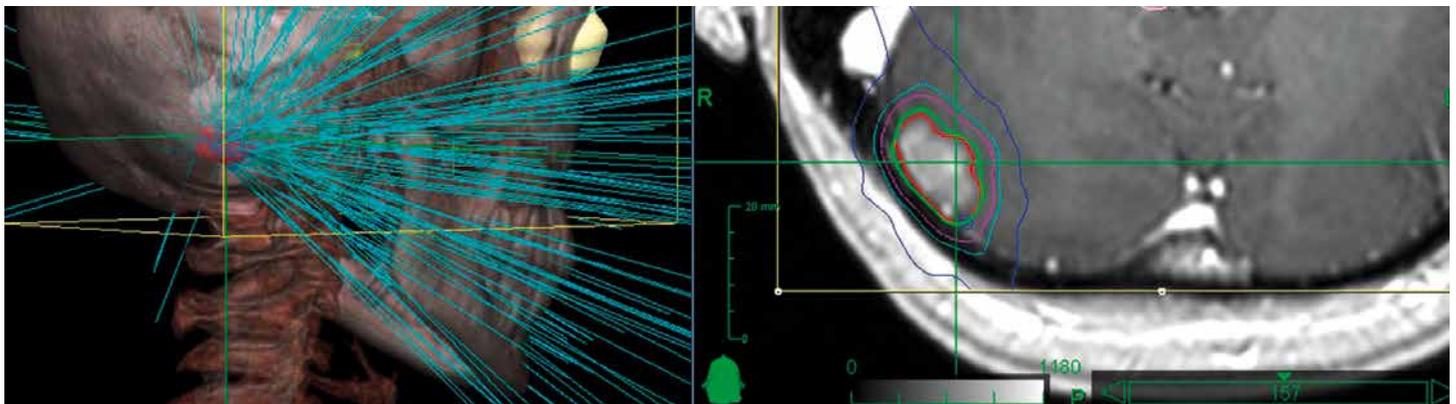
## 2. Treatment planning

Before the treatment, a special CT scan is acquired in order to exactly plan the radiosurgery in terms of the position and shape of the tumor and taking into account the individual body shape. This study is conducted at the CT scanner in RadioChirurgicum, which is closely tuned to the Cyber-Knife® system and which provides the imaging method with the least distortion. All other image data, such as MRI, PET, or functional imaging data (f-ART, i-ART) are then fused with the CT data within the planning software. This guarantees not only the highest possible level of accuracy

concerning artefacts but allows also to acquire the maximum amount of anatomical information by integrating all other imaging methods for the treatment planning. Based on these data the physicians at the RadioChirurgicum define precisely the target to be treated radiosurgically and also outline adjacent anatomical structures and organs at risk which have to be spared from the radiation beams in the treatment plan. The planning computer creates from approximately 1,800 possible beam-directions for irradiation the optimal beam distribution, which covers the tumor

completely with an effective dose – and at the same time protects healthy surrounding tissues and organs as much as possible. Prior to the real treatment the treatment plan is repetitively simulated on a computer device to achieve the optimal dose distribution for the underlying individual situation.

For treatments of tumors in the head or the neck area, special plastic masks are prepared to ensure an exact reproducibility of the positioning high precision of the treatment.



During the course of treatment the location of the tumor is drawn in by the attending physician. The required treatment dose is achieved by irradiation from many different directions. Each beam is represented as a blue line (left).

### 3. The treatment

Once the treatment plan is completed, the CyberKnife® treatment starts. Since the radiation is focused precisely on the tumor by using the radiosurgery method, organs outside the treated region and the body are almost not affected by the therapy. Your overall physical performance will therefore be not affected by the treatment. In the treatment room you will first be positioned comfortably on the treatment table. Then the computer-controlled robot – the CyberKnife® system – will move gently around you without touching you, to irradiate the tumor from different angles according to the treatment plan.

Simultaneously, the CyberKnife® system continuously takes and receives x-rays, to provide a real-time information regarding

the position of your body and the tumor. This allows the system to detect slight movement of your body, as well as tumor movements within the body such as respiratory motion. The system adjusts to this in real time correcting its position and

the angle of the beam guaranteeing a high precision throughout the entire duration of the treatment. Depending on the type and position of the tumor, only one to five treatment sessions are necessary, each lasting between 30 to 90 minutes.



### 4. Follow Up

After three to six months, you come back to the RadioChirurgicum for a follow up consultation with the latest radiological images of the irradiated region.

Appointments can be made already at the end of treatment before you leave our center. Of course the team of RadioChirurgicum is also, always available for you if any questions come up.

For acute problems or complaints you can come to our center even without an appointment.

# Indications at glance

What kind of tumor disease can be treated with the CyberKnife®?

The treatment with the CyberKnife® suits basically to all tumor diseases in which the tumor or the residual tumor presents a circumscribed or just locally limited problem of relevance.

The CyberKnife® can be used in many cases if a removal with a scalpel is not possible or not wanted by the patient. The CyberKnife® can be the best treatment for patients, who have a high risk for surgery due to the location of the tumor or other special medical circumstances, or if the surgical removal is technically not possible.

Furthermore the CyberKnife®-radiosurgery can be used to treat vascular malformations like angioma or in pain syndromes such as the trigeminal neuralgia.

Talk to us about your individual disease and the possibilities of treatment!

## Head and Neck

Acoustic neurinoma, certain cases of tumors in the ear, nose and throat region. In particular well circumscribed, unresectable recurrences after conventional radiotherapy of naso- or oropharyngeal carcinoma and certain tumors of the skull base region, glomus tumors and metastases.

## Liver

Certain cases of Hepatocellular carcinoma (liver cancer) and cholangiocarcinoma, solitary or well circumscribed, limited liver metastases

## Kidney

Certain cases of renal cell carcinomas and metastases in the kidney

## Prostate

Prostate cancer (currently under scientific evaluation)

## Brain

Brain metastases, skull base tumors, acoustic neurinomas, meningiomas, arteriovenous malformations (angiomas), pituitary adenomas, trigeminal neuralgia

## Lunges

Early stage, irresectable Bronchial carcinoma (lung cancer), lung metastases

## Pancreas

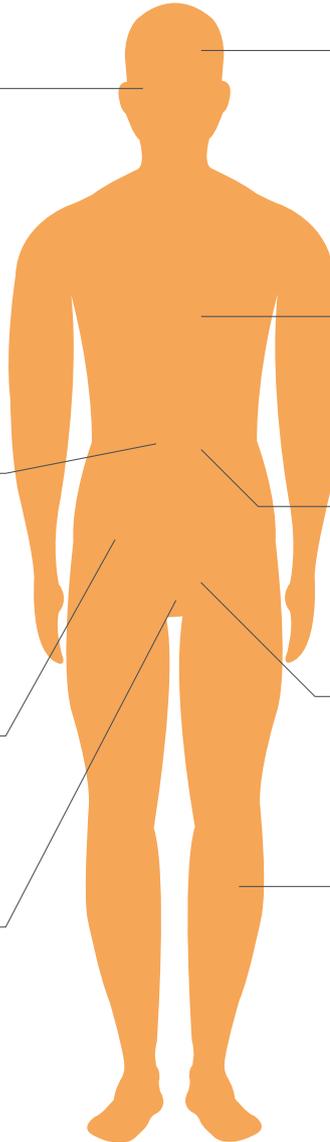
Selected cases of pancreatic cancer

## Spine and spinal canal

Tumors and metastases at and in the spine, epidural tumors

## Bones

Selected cases of bone metastases



## Members of the medical team in the Radiochirurgicum

A high level of concentrated knowledge and expertise in the fields of neurosurgery, radiotherapy and medical physics

The CyberKnife® team of the center RadioChirurgicum consists of a group of highly specialized and experienced radiation oncologists and neurosurgeons who are active in leading positions in various clinics all over Germany treating their own patients in the RadioChirurgicum in Göttingen with the CyberKnife®. All physicians have decades of experience in their field. In addition to the CyberKnife® radio-

surgery, we offer almost the complete range of neurosurgical and radiotherapeutic treatments.

The RadioChirurgicum merges all the experiences of the various disciplines to provide dedicated skills adapted to your needs. Our team of experts in the RadioChirurgicum is supported by specially trained medical technicians, X-ray assis-

tants, nurses and medical assistants. The patients will be accompanied professionally, competently and empathetically during and after the CyberKnife® treatment. A psycho - oncological service is also available to take care of the patients.

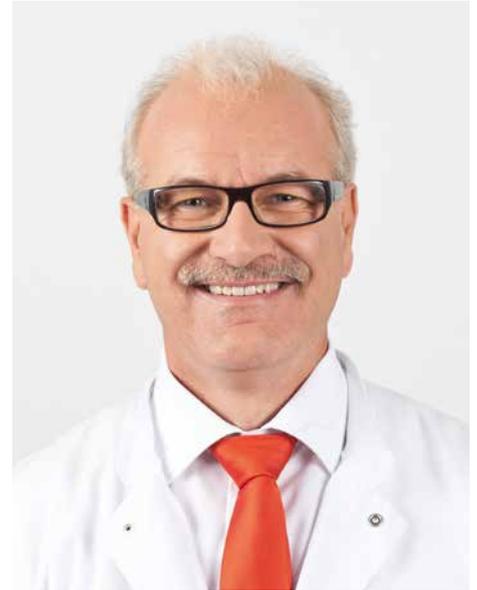


## Prof. Dr. Gerd Becker

Medical director | Clinic for Radiology and Practice for Radiotherapy | Alb Fils  
Kliniken Göppingen

Since 1985 Prof. Dr. Gerd Becker is a medical specialist in the field of radiotherapy, deals with modern radiotherapeutic and radiosurgical methods. In cooperation with colleagues from Heidelberg, he developed basics of the clinical practice in the field of radiosurgery and the fractionated stereotactic conformation radiotherapy. Thereby he had influenced the development of radiosurgical treatment strategies worldwide.

After his move to the clinic Eichert in Göppingen, the department under his direction has been certified to be the first center nationwide, the oncological center of Baden Württemberg as well as the oncological center of the German Cancer Society. Due to his extraordinary recognition Prof. Dr. Gerd Becker is the chairman of the radiation therapists in Baden Württemberg and since 2013 also the managing director of the new RadioChirurgicum.



## Prof. Dr. Martin Bleif

Senior physician | Clinic for Radiology and Practice for Radiotherapy |  
Alb Fils Kliniken Göppingen

Prof. Dr. Martin Bleif is a medical specialist in the field of radiotherapy and worked for a long time as a senior physician and vice medical director at the clinic for radiation oncology of the University of Tübingen. There he worked on the optimization of radiosurgery of brain tumours and brain metastases and established radiosurgery concept for primary lung tumours and metastases in lung and liver. He was member in the executive board of the compre-

hensive cancer centre of the University of Tübingen, one of the leading cancer centers in Germany.

Since 2012 he is the senior physician at the clinic for radiooncology at the Alb Fils Clinic in Göppingen and since 2013 he is the managing director of the RadioChirurgicum. He overlooks the complete spectrum of the radiooncologic cancer therapy.

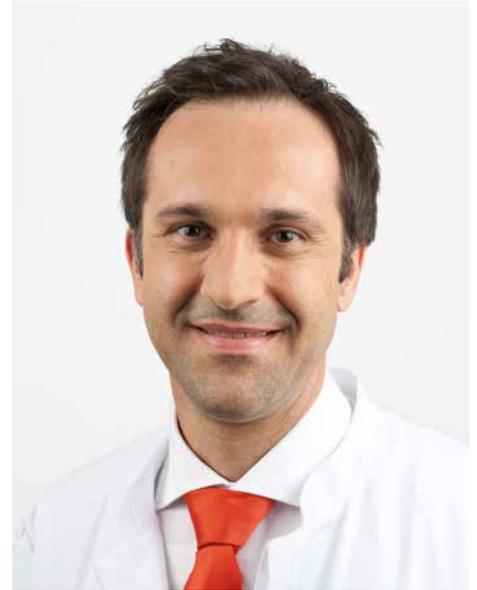


## PD Dr. Dr. Günther Feigl

Senior Physician | Clinic for neurosurgery | Clinic Bamberg

After his studies and perennial brain tumor research in the U.S., PD Dr. Dr. Günther Feigl already started within his dissertation with radiosurgery at treatments of pituitary tumors with the Gamma Knife system. He absolved his specialized training at worldwide prestigious neurosurgeons in Hannover (Prof. Samii) and Tübingen (Prof. Tatagiba) and is today senior physician of the neurosurgery at the clinic of Bamberg.

His specialties are in the fields of surgery of the cranial base and neurooncology. He habilitated at the Eberhard Karls University with his work about the use of radiosurgery in the field of neurosurgery. With his expertise as a neurosurgeon and many years experience in radiosurgery he is able to function as a cooperation-partner for the patient to work out the most suitable therapy program.



## Prof. Dr. Nikolai Hopf

Medical Director | Neurosurgical clinic | NeuroChirurgicum Stuttgart

During his medical studies in Mainz and Morgantown/WV/USA Prof. Dr. Hopf worked intensively in the field of neurosciences. He started to absolve his specialized training in 1990 at the prestigious neurosurgical university clinic in Mainz under the direction of Prof. Axel Perneczky. At that time he spent some months at different neurosurgical specialist departments in the US. In 1996 completed his specialist training in neurosurgery, in 2000 he received the *venia legendi* in the field of neurosurgery.

Between 2003 and 2014 Prof. Dr. Hopf was the medical director of the neurosurgical clinic at the clinic Stuttgart. In 2014 he found the Neurochirurgicum, a specialized center for minimal invasive neurosurgery in Stuttgart, Germany. In addition to numerous national and international memberships, e.g. German Cancer Society, he published a variety of specialist publications. As cooperation partner he bridges the gap between RadioChirurgicums and the clinic of Stuttgart.



## Prof. Dr. Dr. h.c. Uwe Spetzger

Medical director | Neurosurgical clinic | Clinic of Karlsruhe

Prof. Spetzger absolved his specialized training at the neurosurgical University clinic of FWH Aachen. From 1996 he worked there as a senior physician and after his habilitation in 1999 he worked for three years as a chief senior physician at the neurosurgical university clinic of Freiburg. His specialties are the vascular neurosurgery and the surgery of the cranial base as well as minimally invasive spinal column surgery. Prof. Spetzger is a member of many national and interna-

tional medical associations and currently president of the international Society for medical Innovation and Technology (SMIT). Since 2002 he is the director of the neurosurgical clinic of the urban clinic Karlsruhe and also faculty member of the institute for Anthropometric of the faculty of Informatics at the Institute for technology (KIT) in Karlsruhe. As cooperation partner he bridges the gap between RadioChirurgicum and Karlsruhe.



## PD Dr. Dr. Andreas Mack

PTGR- physically technical Company for radiology

PD Dr. Dr. Andreas Mack, managing director of the PTGR, has treated and supervised several thousands patient in his long radio-surgical career with neurosurgeons and radiotherapists. After his Ph.D. at the University of Tübingen PD Dr. Dr. Mack became senior physicist and radiation protective representative at the Gamma Knife center in Munich and established in 2001 the Gamma Knife center in Frankfurt. By writing "Development of methods of qual-

ity assurance in the field of radiosurgery" PD Dr. Dr. Mack was habilitated in 2006.

Since 2008 PD Dr. Dr. Mack supervises CyberKnife® in Zurich as a medical physicist. With the physical-technical company for radiology, he works as an advisory cooperation partner at the RadioChirurgicum in Göppingen.

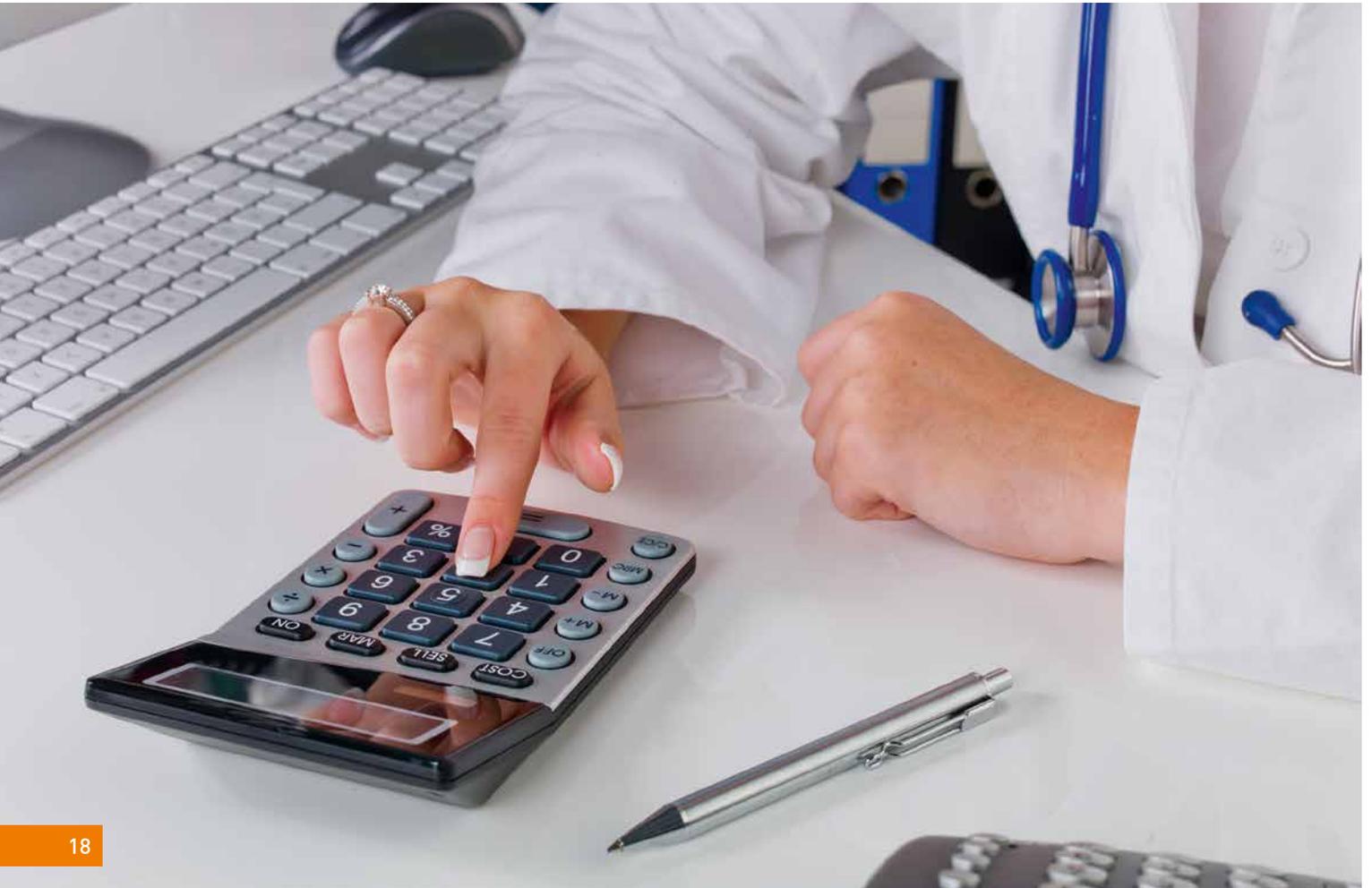


# Who pays for the CyberKnife® treatment?

## Questions about reimbursement

For each foreign patient the costs for were individually calculated and and fixed and reliable offer will be made prior to the treatment. Our team at the RadioChirurgicum is pleased to provide information for possibilities of reimbursement of costs through

your health insurance and will support you with the formalities. Many foreign health insurances in Europe will cover the costs, if comparable treatment is not available at home.



## Your point of contact

We are happy to advise you on the topic of CyberKnife® treatment

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Göppingen, Germany

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Talk to one of our physicians about your individual treatment options with the CyberKnife®.  
For further information: [www.radiochirurgicum.de](http://www.radiochirurgicum.de)

# How to get here

## Driving Directions

The RadioChirurgicum/CyberKnife® South-West is affiliated with the Department of Radiation Oncology and Private Practice of Radiation of the Alb Fils clinics and is located in the clinic at Eichert in Göppingen. Parking is available in front of the hospital entrance. From there follow the signs to RadioChirurgicum, which is located in the basement of the hospital building (U7).

