From X-Rays to Magnetic Resonance

A Würzburg Story of Medical Imaging

1895-1985-Today

Würzburg Makes the Invisible Visible

From X-rays to magnetic resonance – a technological development with a personal connection

Historic X-ray table from the Röntgen Museum in Würzburg.

In 1895, Wilhelm Conrad Röntgen discovered the X-rays that would later bear his name in Würzburg.
This discovery marked the beginning of medical imaging and fundamentally changed medical diagnosis and therapy worldwide

Wilhelm Conrad Röntgen (1845–1923)
Discoverer of X-rays in Würzburg in 1895.

As early as 1896, the industrial implementation of this new technology began in Erlangen.
Alongside Reiniger, Gebbert & Schall, the company **Hofmann in Erlangen** also developed early X-ray systems and contributed to the technical spread of radiographic diagnostics.From these industrial roots, the medical technology activities of **Siemens** later emerged.
Nearly ninety years after Röntgen's discovery, a new era of imaging began.
Unlike X-ray technology, **magnetic resonance imaging (MRI)** does not rely on ionizing radiation but on the resonance of hydrogen protons within a magnetic field.
The image is not created by radiation passing through the body, but by signals originating from inside the body.

In 1984 Siemens introduced the **MAGNETOM**, one of the first commercially available MRI systems.
One of the key personalities of this development phase was **Arnulf Oppelt**, who played an important role in the technical design and clinical introduction of magnetic resonance imaging.

In 1985 one of the early clinical MRI systems was installed in Würzburg.With this installation a remarkable circle was completed:
The city in which X-rays were first discovered once again became a place where a new chapter of medical imaging began — linking scientific history with technological progress and innovation with personal commitment.

For **Hubert Noras**, this development is closely connected with his own professional career.
In his early years he worked on the installation and repair of X-ray systems, among others for Hofmann in Erlangen. Later he collaborated closely with Arnulf Oppelt in the field of MRI technology and contributed to the development of specialized positioning systems for neurosurgical procedures under MRI guidance.

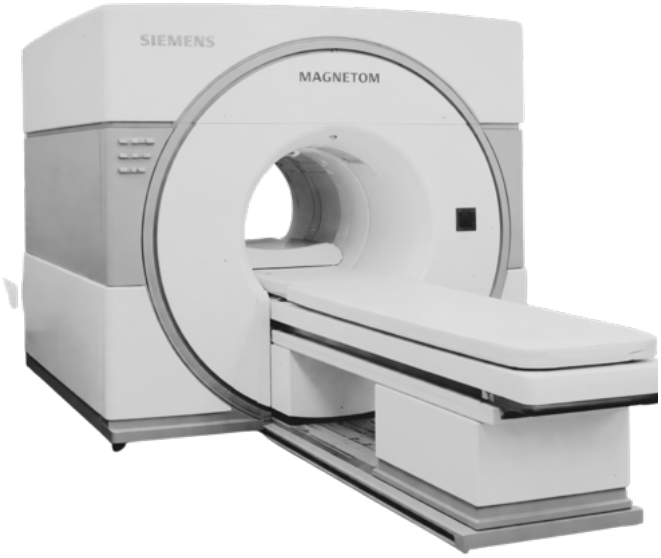
The transition from X-ray technology to magnetic resonance imaging is therefore not only a story of technological progress.
It also represents a continuity of Franconian engineering between Würzburg and Erlangen spanning almost a century.

From radiation coming from outside
to signals originating from inside the body.

The Courage of a Radiologist

At the beginning of the 1980s, when magnetic resonance imaging (MRI)

was still considered an experimental high-technology, the Würzburg radiologist **Dr. Wolfgang Keil** made an early decision in favor of this new form of medical imaging.



Even before the technology had become widely established, he planned to build his own MRI practice in Würzburg. With this decision he became one of the pioneers of early clinical MRI applications in Germany.

The technical requirements were extraordinary:

• The building foundation had to be reinforced because of the enormous weight of the magnet.

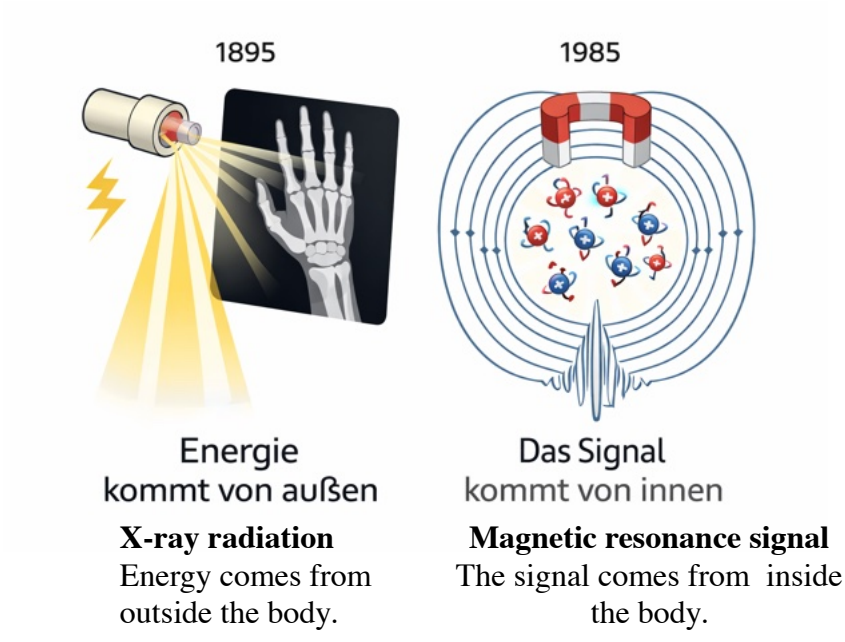
• Vibrations from road traffic and the nearby tramline had to be structurally isolated.

• Shielding made of steel and copper was required to prevent electromagnetic interference.

• The supply of helium and nitrogen for cooling the superconducting magnet created completely new logistical challenges.

Establishing this practice was not a routine project — it was a bold step into a new technological era.

Würzburg thus became not only the historical birthplace of X-rays, but once again a place where pioneering work in medical imaging took place.



X-ray radiation
Energy comes from outside the body.

Magnetic resonance signal
The signal comes from inside the body.

The First Phase of Operation

With the installation of the magnetic resonance system, a new phase of medical imaging began in Würzburg in 1985.

At that time, the routine operation of such a system was far from self-evident.The system operated with a **superconducting magnet** that had to be continuously cooled with liquid helium and nitrogen.
regular monitoring of the cooling system and refilling of the cryogens were safety-relevant tasks and were usually carried out outside normal working hours.

Filling of the superconducting magnet with liquid helium during the early operational phase of MRI in Würzburg. Noras was involved in the technical planning and infrastructural preparation of the facility.

In addition to the technical supervision of the system, further development needs soon became apparent. Standard components were often insufficient for specific clinical questions.
Particularly in the areas of **coil technology** and **patient positioning**, individual technical solutions had to be developed.

In this early phase, operating the system was therefore not only the application of existing technology — it also became an environment for the development of new approaches in MRI diagnostics.

Transition to Development

Shortly after the system was put into operation, it became clear that MRI technology was groundbreaking, but still required further technical adaptations for daily clinical work — particularly in positioning, fixation and anatomical adjustment for specialized examinations.

From these practical requirements, early developments of MR-compatible components emerged.

Early Coil Developments

It soon became evident that the standard coils were not suitable for all anatomical situations.

The first constructive solutions did not arise on a drawing board but directly from the practical requirements of everyday examinations.
One of the early developments was an anatomically shaped **spine coil**, which allowed better positioning of the patient and improved image quality.

Early version of a spine coil movable beneath the patient, developed in Würzburg during the early phase of MRI development (Noras Medizintechnik).

In the following years further coils adapted to different anatomical regions were developed, including coils for the **shoulder, hand, elbow and knee**.
The goal was always to improve image quality while positioning the coil as close as possible to the patient.

At the same time, early concepts of **flexible coil systems** were tested in order to examine several body regions with adaptable coil configurations.

Reorientation and New Beginnings in Suhl (1990)

Company facility of NORAS X-ray and Medical Technology in Suhl.

In January 1990, Hubert Noras founded a company in Thuringia, still at the time of the former GDR.
Together with **Dr. Wolfgang Keil**, the plan was to establish an institute for MRI examinations as well as for research and development.
A suitable property was selected and acquired for this purpose.

However, after the sudden death of Dr. Keil, this project could no longer be realized as originally planned.
The concept of building a clinical development center had to be reconsidered.

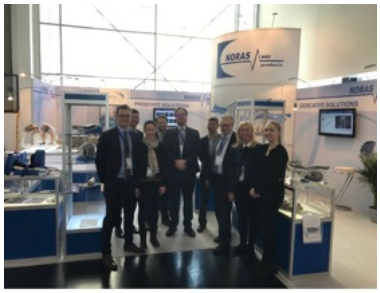
As a consequence, a new professional direction emerged.
In Suhl a company building was constructed that was initially used for the distribution and service of medical technology equipment.
During this period Noras also represented **electromedical systems from Siemens**.

First Noras exhibition booth, self-built, ECR Vienna, 1993

The originally planned research and development activities were later relocated back to **Würzburg**.
In the following years, development and production increasingly focused on specialized MRI components.

International Networking from 1993

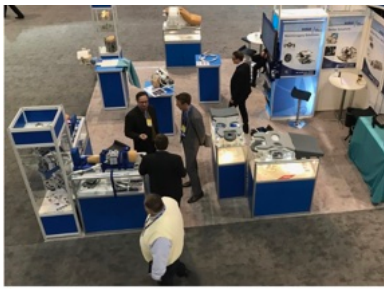
In 1993 Noras attended the Radiological Society of North America (RSNA) congress in Chicago, the largest radiology conference in the world.
There he met **Tom Schubert**, founder of MRI Devices Corporation, an American company that had already developed coils for the next generation of MRI systems for GE.



Noras boot. ECR Wien

From this contact emerged the European representation of **MRI Devices Corporation** through Noras in Würzburg.
For the first time, specialized third-party coils that were not part of the original equipment of the major manufacturers were systematically introduced into the European market.

During this time Würzburg developed into an important European distribution center for these systems.
This international cooperation represented another milestone in the technical development.



Noras booth, RSNA Chicago

International Radiology Congresses

The introduction of new MRI components required an international presence at professional congresses.
In the following years Noras regularly participated in conferences such as:

- **RSNA in Chicago**
- **European Congress of Radiology (ECR) in Vienna**
- **German Radiology Congress**
- as well as other radiological and medical physics meetings worldwide.

These events provided the platform to present new coil systems internationally and gradually bring them into clinical use across Europe.

Development of an MRI-Guided Breast Biopsy System

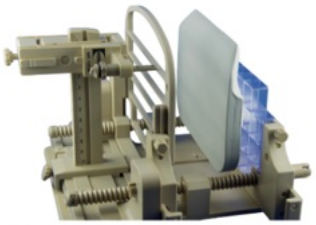
With the increasing use of MRI diagnostics, the need arose for precise interventional systems that would allow targeted tissue sampling under imaging control.

The solutions available at that time were technically functional, but in practical use they had several limitations.
Separate positioning elements and additional working steps made it difficult to maintain a continuous and controlled workflow inside the magnetic field.

First prototype with coil

For this reason, Noras developed a **fully MRI-compatible breast biopsy unit**.
The system consisted of magnetically and radiofrequency-neutral components and was manufactured from high-strength plastic (**PEEK**) in order to avoid interference with the magnetic field and the RF signals.

The target coordinates were determined directly from the MRI image data. In combination with a specially developed **breast coil**, the biopsy needle could be guided precisely and monitored directly within the MRI system.



MRI-compatible breast biopsy unit made from high-strength plastic (PEEK), developed in Würzburg.

In cooperation with **Prof. Werner Kaiser** at the University of Jena, the system was introduced into clinical use.
The positive results led to the systematic establishment of MRI-guided breast biopsy at that institution.

Prof. Kaiser was later awarded the **Federal Cross of Merit (Bundesverdienstkreuz)** for his contributions to medical imaging.

Prof. Werner Kaiser thanks Hubert Noras during his farewell speech in Jena for their many years of collaboration.

Development of MRI-Compatible Head Fixation Systems with Integrated Coil

With the increasing use of MRI in neurodiagnostics, the need arose for stable and reproducible positioning systems for the patient's head – particularly for interventional and neurosurgical procedures.

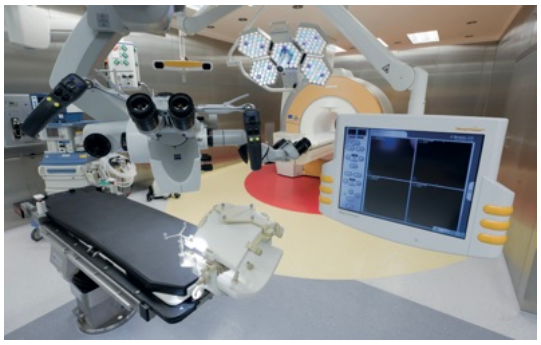
Early systems, especially those used in **0.2-Tesla MRI systems**, showed structural limitations in terms of stability and coil integration.

First Developments (0.2 T and 1.5 T)

Against this background, Hubert Noras was commissioned to further develop an **MRI-compatible head fixation system**for low-field systems (0.2 T).

The main objectives were:

- improved mechanical stability
- more precise adjustability
- integration of a suitable RF coil



BrainLAB Suite – Intraoperative MRI (1.5 Tesla)

In the following years additional developments were carried out for **1.5-Tesla MRI systems**, where both the mechanical fixation and the radiofrequency integration were further optimized.

Further Development for 3 Tesla

With the introduction of high-field **3-Tesla MRI systems**, new technical requirements emerged:

• stronger magnetic forces
• higher demands on RF compatibility
• greater geometric precision and stability

In response to these challenges, Noras developed an adapted **head fixation system with an integrated RF coil** designed specifically for high-field MRI environments.

These systems made it possible to create stable conditions for **neurosurgical and interventional procedures** under high-field MRI.

BrainLAB Suite – Intraoperative MRI (1.5 Tesla)
Early single-room concept combining the operating room and MRI.
The first coil was developed in cooperation with Rapid.
Later, NORAS 3-Tesla coils and head fixation systems enabled two-room solutions with patient transfer into the MRI scanner.

Würzburg – Innovation in the Service of Medicine

From the early developments in Würzburg, a company gradually emerged over the decades that specialized in **MRI coils and interventional systems**.

In this way a historical circle closes:

In 1895 **Wilhelm Conrad Röntgen** made the interior of the human body visible for the first time in Würzburg.
Nearly ninety years later, the early clinical use of **magnetic resonance imaging** began in the same city.
And even today, technical solutions continue to be developed in Würzburg that contribute to improved imaging, earlier cancer detection and a better quality of life for patients.
Not as spectacular headlines –
but as **continuous engineering work in the service of medicine**.

Relocation to Höchberg

With the move into new development and production facilities in **Höchberg near Würzburg in 2004**, the earlier distribution activities for international partner companies came to an end.

Since then, Noras has focused entirely on the **independent development, manufacturing and worldwide application of its own MRI coils and biopsy systems from Würzburg**.

Company headquarters in Höchberg near Würzburg, since 2004.

Würzburg – From X-rays to Magnetic Resonance

The history of medical imaging is closely connected with the city of Würzburg.

It was here that **Wilhelm Conrad Röntgen** discovered the X-rays in 1895 and opened a completely new chapter in medicine.

Many decades later Würzburg again became an important place for medical imaging – this time in the field of **magnetic resonance imaging (MRI)**.

An important step in the development of fast MRI methods took place in the 1980s at the **Max Planck Institute for Biophysical Chemistry in Göttingen**, where **Prof. Axel Haase** and **Prof. Jens Frahm**, together with their colleagues, developed fundamental work on fast MR sequences such as **FLASH (Fast Low Angle Shot)**.

This method made significantly faster MRI imaging possible and laid the foundation for many later clinical applications.

When **Prof. Axel Haase** later moved to the **University of Würzburg**, a strong research group for magnetic resonance imaging was established there. Würzburg once again became an important center for new MRI methods and applications.

During this period I worked with my companies **NORAS Röntgentechnik** and later **NORAS MRI Products** in close cooperation with several scientific groups.

With **Prof. Axel Haase** I maintained a long-standing collaboration in Würzburg, where many practical solutions and specialized MRI coils from Würzburg were developed for new MRI applications.

I also worked early with **Prof. Jürgen Hennig** at the University of Freiburg.
For a **2-Tesla research system**, I developed a special head coil that allowed improved visualization of structures of the brain, particularly in the region of the cerebellum.

These developments supported early research in **functional brain imaging**, where language, images or films were used to visualize activity in different areas of the brain.

There was also a close collaboration with **Prof. Jens Frahm** in Göttingen for high-resolution MRI research applications.

Many of the technical solutions and MRI coils developed during this time were widely used in scientific research.
Based on these developments numerous **diploma theses, doctoral theses and later master theses** were completed, opening new applications of magnetic resonance imaging.

The cooperation between **university research and practical engineering development** played an important role.
Many ideas from research could only be translated into clinical practice through specialized coils and technical solutions.

In this sense a circle closes once again:

From the discovery of X-rays in Würzburg to modern developments in magnetic resonance imaging – new impulses for medical imaging have repeatedly emerged from this city.

A small part of this path could also be shaped by my work and by the developments of **NORAS in Würzburg**.

Innovation often begins with an idea –
and sometimes with a small workshop in Würz

I was not a university professor, but my developments accompanied many doctors and scientists in their work and became part of their daily clinical practice.

For me, this story is more than a technical development.

This photograph was taken during the introduction of a new MRI system with a **70 cm bore**, which for the first time provided significantly more space for both patient and equipment.

With this image I demonstrated that **NORAS coils** were also suitable for this new generation of MRI systems – and it marked the beginning of my collaboration with **Siemens**.

It connects places, people and generations – from the discovery of X-rays in Würzburg to modern magnetic resonance imaging.

I had the privilege to accompany a small part of this journey – from the installation of early systems to my own technical developments and to applications that have today become part of everyday medical practice.

Technology does not arise in the spotlight, but in daily work: in workshops, in hospitals and through cooperation with doctors and researchers. What always mattered was never the name on a device, but the question whether it helped the patient.

If Würzburg today once again stands for medical innovation, this is no coincidence, but the result of continuous work.

And this work continues – also for the generations to come.

Progress is created by people
who are not in the spotlight –
but who make the path possible.

A Thumb for Progress

Hubert Noras
Würzburg, 2025

Milestones in MRI Coil Development

1985 — Foundation of **NORAS X-ray and Medical Technology**
↓
1995 — Patent for an **MRI-guided breast biopsy system**
↓
2001–2005 — Development of **intraoperative MRI coils**
↓
2005 — Renaming to **NORAS MRI Products GmbH**
↓
2009 — First **OEM breast biopsy coil for Siemens**
↓
2016 — Development of the **multi-channel dental MRI coil**
↓
2017 — Second **OEM breast biopsy coil for Siemens**
↓
2022 — Transition of the company to **Manuel Noras**

NORAS
MRI PRODUCTS

Hubert Noras

Founder and Managing Director
NORAS Röntgen- und Medizintechnik
later NORAS MRI products GmbH

Since 1985 developer of specialized MRI coils
and interventional systems for medical imaging.

Technologies developed in Würzburg
have been used worldwide in research and clinical practice.

Würzburg / Höchberg
2025