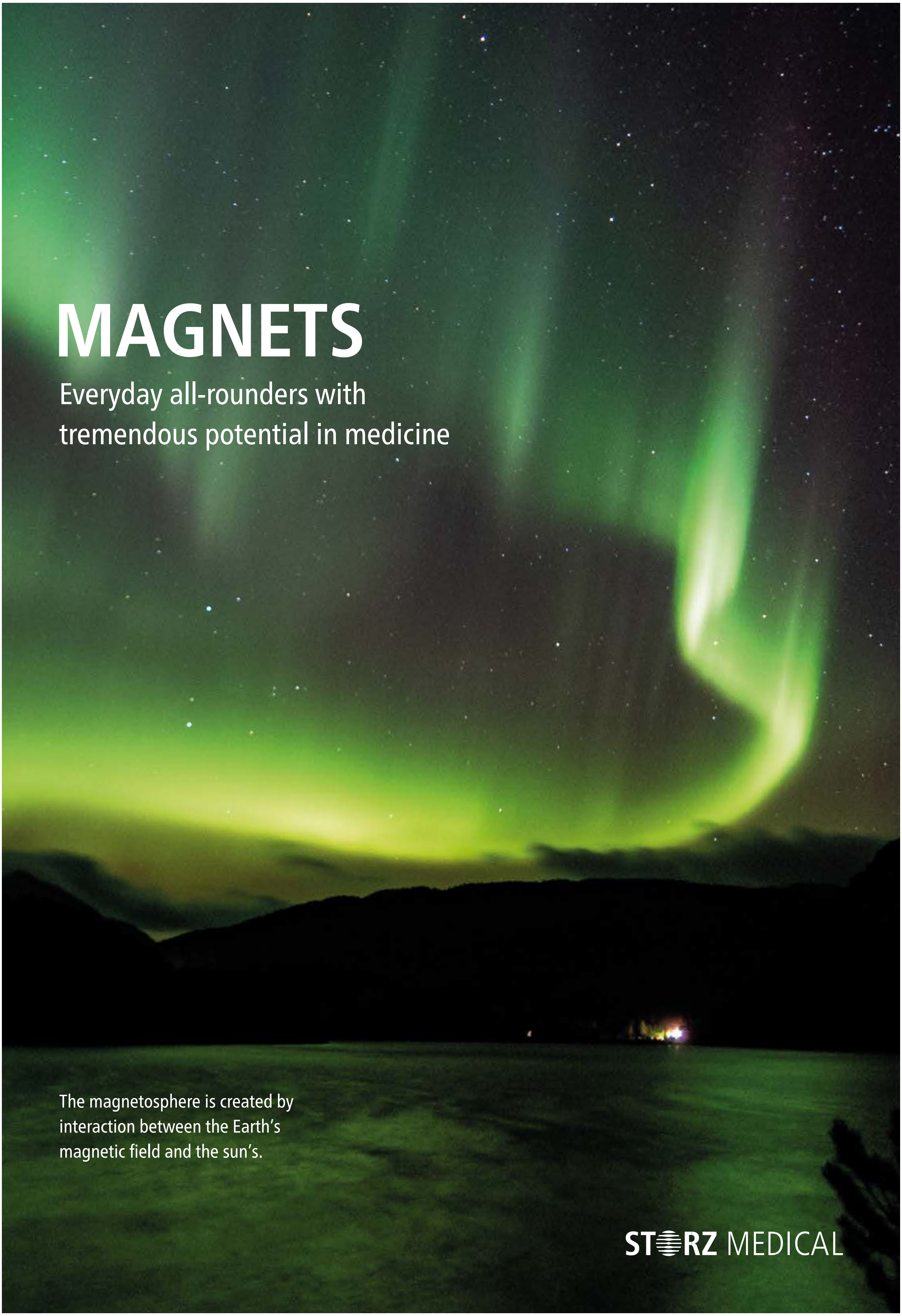


MAGNETS

Everyday all-rounders with tremendous potential in medicine

The magnetosphere is created by interaction between the Earth's magnetic field and the sun's.

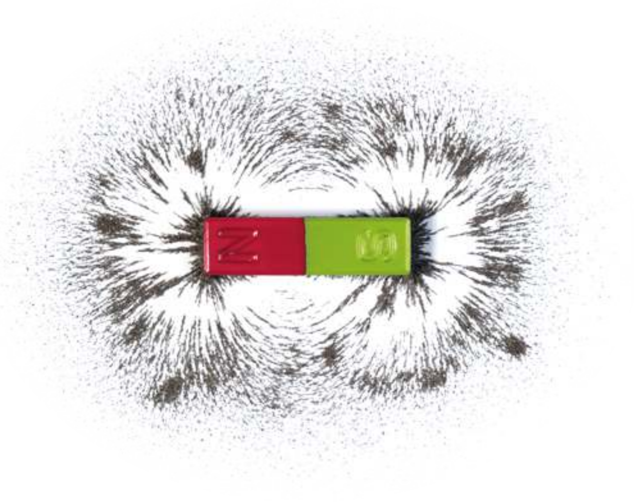
STORZ MEDICAL

MAGNETS

Everyday all-rounders with tremendous potential in medicine

At home, on the road or in hospital: magnets are everywhere in our technological society, and are used in a very wide range of everyday situations. Especially in medicine, there are numerous promising advances that harness the potential of magnets.

Our ancestors discovered magnetism thousands of years ago in the form of magnetite, a mineral rich in iron. Initially, its only practical application was the compass, with these first being used for navigation purposes around the year 1000. It was not until 1820 that Danish physicist Hans Christian Ørsted established the relationship between magnetism and its »twin«, electricity. Among the pioneers who put this insight into practice was English physicist William Sturgeon who, in 1825, took an iron core and wound it with 18 turns of copper wire, thus creating a simple electromagnet.



Magnetic field lines with iron filings

The 19th century saw further scientific discoveries, which brought many technological innovations in their wake. If it had not been for these achievements, there are many things we would not have today – from refrigerator magnets to many other useful things such as loudspeakers, induction cooker hobs, hard drives, electric motors and cardiac pacemakers.

Magnets in cutting-edge technology

The 21st century saw no let-up in the search for new uses. The following notable examples show just how essential magnets are to making recent cutting-edge technologies work.

Let's start with the Tesla Model X. This electric vehicle obtains its propulsive force from what is known as a four-pole three-phase asynchronous motor. The term »four-pole« refers to the motor's electromagnets. These are 12 long coils, arranged adjacently in tubular form, which constitute the stationary part of the motor (called the stator). Inside the stator there is a rotor, a cylinder that consists of metal strips. In the most powerful model, two motors of this kind ensure acceleration from 0 to 100 km/h in a mere 2.1 seconds.

The second example is a small device that, for many of us, is an extension of our hand: the smartphone. Without magnets, we would be deprived of most of its highly useful functions. These devices would be silent, since neither the receiver nor the speaker would work.

What's more, without their built-in magnetic sensor – a digital compass – smartphones would lose their orientation capacity. And they would also be extremely uncommunicative, since the electromagnetic waves (radio waves) they use are the crucial technical prerequisite which makes telephoning on the go possible.

The third example is taken from medical technology. For many people, the largest and strongest magnets they will ever encounter are hidden away in magnetic resonance imaging (MRI) scanners. The field strength of most medical MRI scanners is between 1 and 3 T (tesla), equivalent to a strength of 10,000 – 30,000 G (gauss). Without magnets, this revolutionary imaging technique would never have become reality.

Micromagnets open up new therapeutic options

Wireless deep brain stimulation, nanomedicine or artificial skin: the incredible versatility of micromagnets means that new medical applications are constantly being developed. In the near future, magnetic particles may be the key to breakthroughs such as touch-sensitive robotic prostheses, novel cancer treatments and alternative antibiotics. And even therapies for our most complex organ – the brain – could be radically changed with magnetic nanoparticles. In the treatment of depression, Parkinson's disease, and other psychiatric and neurological conditions, new procedures involving deep brain stimulation could come into play that have potential to improve all of our lives.

Extracorporeal Magnetotransduction Therapy (EMTT) from STORZ MEDICAL

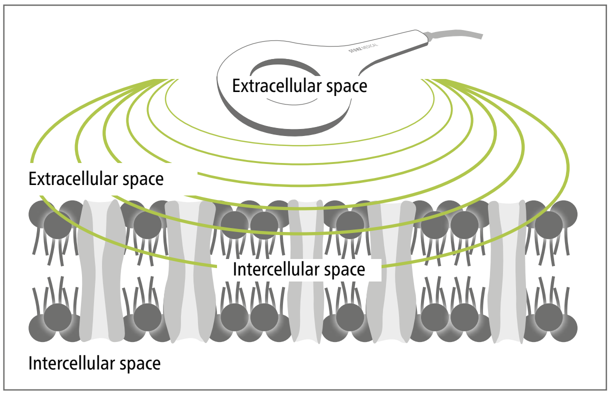
In the form of Extracorporeal Magnetotransduction Therapy (EMTT), STORZ MEDICAL offers a new, non-invasive procedure for treating chronic musculoskeletal disorders. A high-performance therapy device called MAGNETOLITH® is highly impressive in terms of its range of applications, patient comfort and ease of handling.

Example of dynamic treatment: the knee joint

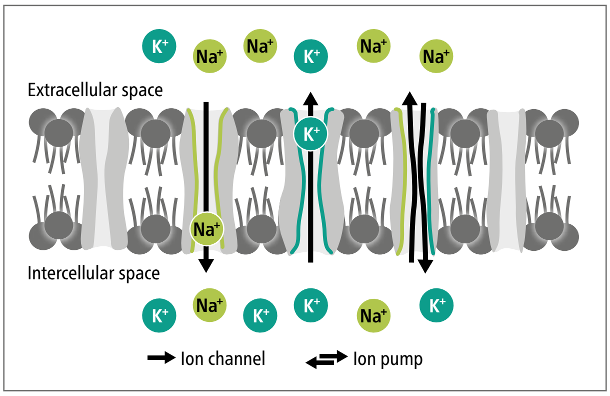
Example of static treatment with the holding arm: the shoulder

EMTT – new horizons in therapy and rehabilitation

Applications include musculoskeletal conditions such as low back pain, osteoarthritis, and inflammation of the tendons and joints. EMTT differs from other general forms of magnetic field therapy (including pulsed electromagnetic field therapy, PEMF) in that the oscillation frequency and magnetic field strength are higher, resulting in strong »effective transduction performance«. It can be assumed that, the faster the pulse rate of the magnetic field – i.e. the higher the effective transduction performance – the greater the bioelectrical activity in the body is. Thanks to these properties, EMTT also allows high penetration depth and a wide range of applications.



High-energy electromagnetic waves hit cell structures.



An intact cell membrane ensures vital physiological processes in the cell take place.

Body regions affected by pain are treated with high-energy magnetic pulses whose field strength lies within the therapeutically effective range, i.e. above 10 mT (milliteslas). At this pulse intensity, the effect inside the cell may be therapeutically relevant. Using an applicator, the energy produced is transferred to the area of the body requiring treatment. The individual pulses penetrate the tissue, so that deeper tissue layers can also be accessed. The short duration of each pulse means that the temperature of the tissue does not increase.

Treatment with the MAGNETOLITH® is relatively quick and straightforward. The applicator is positioned directly above the region of the body requiring treatment, without the need for clothing to be removed. EMTT treatment is carried out at a frequency of up to 10 pulses/s. The pulse strength is adjusted based on the condition to be treated. Depending on indication and frequency, a single treatment takes between 5 and 20 minutes and may be repeated up to eight times over several weeks.

Example of static treatment with the holding arm: low back pain

Example of dynamic treatment: ankle joint

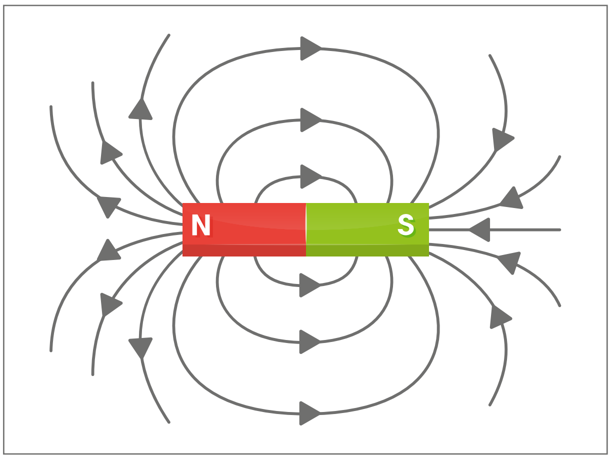
What is a magnet?

»Opposites attract, like repels like«: this fundamental law of magnetism is crucial to thousands of different mechanisms, machines and devices that are a part of everyday modern life.

A standard magnet – they are generally stick- or U-shaped – is made of a ferrous (iron-based) material, usually a form of steel. Its magnetic force is strongest at both ends, which are called the poles. There are two different poles: a north (N) and a south (S) pole.

If two magnets are brought together, one of two things will happen: 'unlike' poles (N and S) will attract each other, and 'like' poles (N and N, or S and S) will repel one another. Magnets can only influence other magnets or objects containing iron, cobalt or nickel.

There is an area around a magnet in which magnetic effects are observed; this is termed a magnetic field. These magnetic fields are visually represented using field lines (see illustration).



Magnetism: the force between magnetic poles

Evidence of significant therapeutic effects with EMTT devices

Krath, A. et al., J Orthop. 2017;14(3):410-415. doi: 10.1016/j.jor.2017.06.016.
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A brief history of magnetism

560 BC
In ancient Greece, Thales of Miletus described how the mineral called magnetite makes iron move.

100 BC
Use of the term »magnet« spreads (the Greek region of Magnesia had large deposits of magnetite).

1088
In China, scientist Shen Kuo describes the basic principles of the magnetic compass.

1600
English scientist William Gilbert describes the fundamental law of magnetism in his work »De Magnete«.

1820
Danish scientist Hans Christian Ørsted observes that passing an electric current through a wire causes the wire to influence a compass needle, thus establishing the link between magnetism and electricity.

1820
André-Marie Ampère, a French scientist, develops a long wire coil that he calls a solenoid. It goes on to become an essential component of electromagnets and many other devices.

1825
English physicist William Sturgeon develops the first electromagnets, consisting of an iron core with wire wrapped around it.

1831
English experimental physicist Michael Faraday discovers electromagnetic induction. This involves a changing magnetic field generating an electric current – and vice versa. Induction goes on to form the basis of electric motors, generators, transformers and many other electromagnetic devices.

1833
Carl Friedrich Gauss, a German physicist, formulates laws of magnetism and installs a viable telegraph system.

1876
Scottish-American scientist Alexander Graham Bell takes out a patent on the telephone.

1917
Japanese engineer Kotaro Honda develops KS steel, enabling magnets to be more powerful and stable.

1923
Henry Round, an English engineer, invents the first practical electromagnetic microphone.

1925
American electrical engineers Edward Kellogg and Chester Rice develop the electrodynamic loudspeaker.

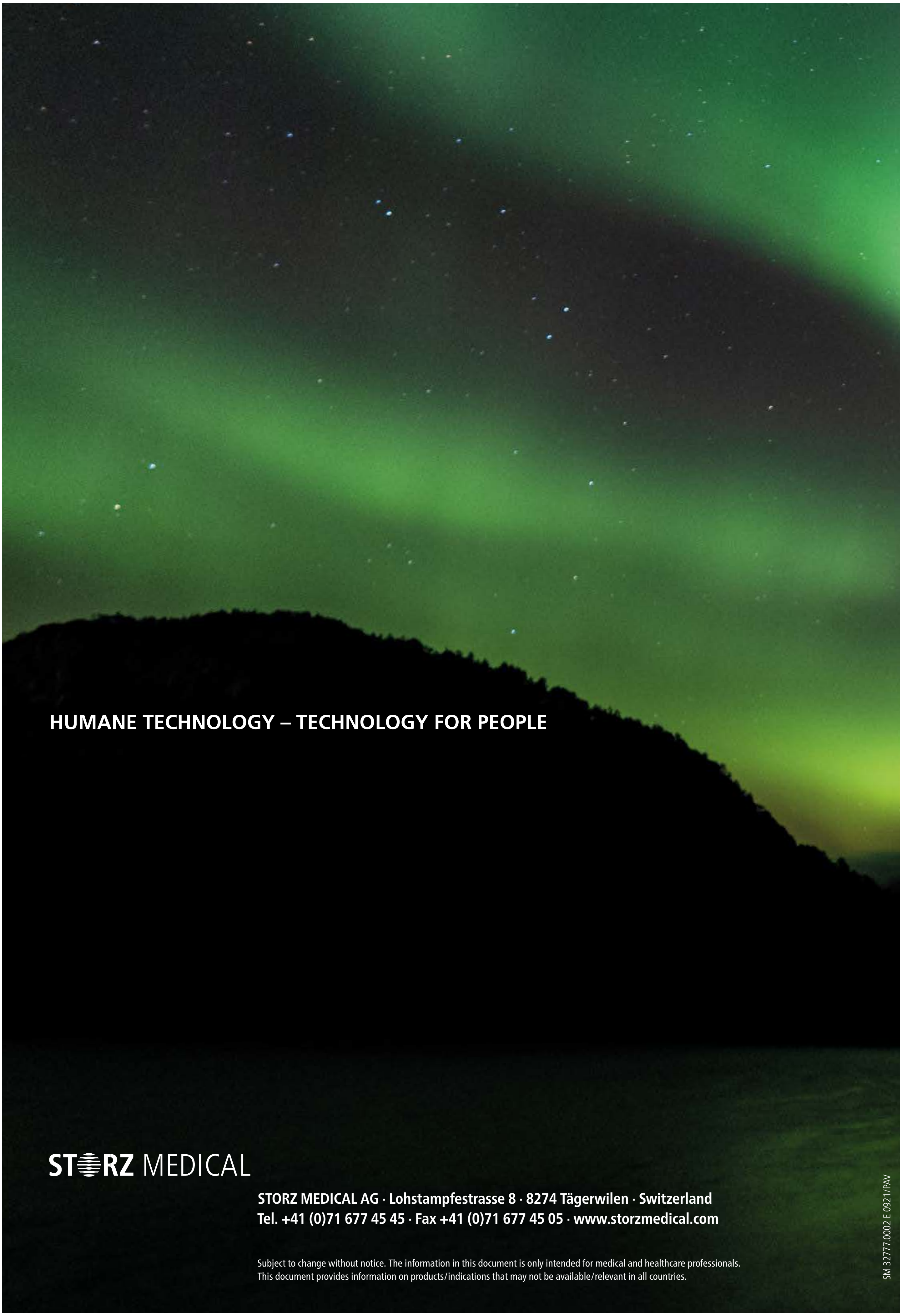
1977/78
American chemist Paul Lauterbur, English physicist Peter Mansfield and American physicist Raymond Damadian contribute to the development of magnetic resonance imaging (MRI).

2007
The iPhone is unveiled.

2015
The Tesla Model X electric car appears on the market.

2015
STORZ MEDICAL presents the CELLACTOR® MT1 – the first EMTT system.

2020
The MAGNETOLITH® is launched.



HUMANE TECHNOLOGY – TECHNOLOGY FOR PEOPLE

STORZ MEDICAL

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