What You Should Know

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You are now one of about two million people who have a cardiac pacemaker implanted. Thanks to this tiny device, people with heart rhythm problems can enjoy a normal life once again.

In the past, pacemakers were implanted only as life-saving devices. Today, BIOTRONIK’s pacemakers are capable of improving the quality of life for many people.
Through pacing, these people are back working at their jobs, looking after their children and grandchildren, as well as pursuing hobbies and travel. Most of all, they are once again capable of maintaining a healthy, fulfilling life.

BIOTRONIK has been making high quality, technologically advanced and reliable pacemakers for more than 30 years.
The Heart and Heart Disorders

The heart is basically a hollow muscle with four chambers – the two atria (the upper chambers) and the two ventricles (the lower chambers). The heart is divided into a right and a left side and is responsible for pumping blood throughout the body. This is necessary in order for all organs and tissues to be supplied with oxygen which they need to function. In order for the blood to be collected and pumped out, the heart depends on tiny electrical impulses passed from the upper chambers to the lower chambers.
These impulses usually start at the sinus node, which is also known as the natural pacemaker. Thus, the sinus node is the one which coordinates contractions and allows the heart to beat rhythmically. Impulses are then carried from the upper chambers into the lower chambers which then contract. This contraction is what you know as a heartbeat.

At rest, a healthy heart beats 60 to 80 times per minute, which is about 100,000 times per day. During physical exercise or emotional stress, the body has a greater need for oxygen.

To adapt to these physiological conditions, the heart rate will be raised to more than 100 beats per minute.

Different reasons, such as disease or age-related processes, can disturb the natural heart rhythm. Very common disorders are problems in the conduction system or possible blockage of the pathways. As a result, the heart may beat irregularly
and/or too slowly. In that case, the body – especially under physical stress – will be insufficiently supplied with oxygen, causing dizziness, feelings of weakness or tiredness. The medical term for these kinds of rhythm disorders is bradycardia.
Two of the most common disorders are sick sinus syndrome and AV block. In sick sinus syndrome, the sinus node does not function correctly, and impulses are generated irregularly or too slowly. The heart is not capable of adapting the heart rate sufficiently to conditions under load.

In the case of AV block, the conduction of the electrical signals between the sinus node (in the atrium) and the AV node (in the ventricle) can be partially or totally blocked. With a total AV block, the electrical conduction between the atrium and the ventricle is interrupted. So a different center of the heart will generate a very slow, auxiliary rhythm to ensure life-saving function.

In either one of these situations, or in other, even less common cases, the heart can be assisted through the use of an artificial pacemaker.
The heart muscle is stimulated by a pacing system through carefully timed electrical pulses that cause the heart to beat in a way similar to a healthy heart rhythm.
Today’s pacemakers can be adapted to meet each patient’s specific needs. When we speak of a pacemaker we actually mean a pacing system which consists of the pacemaker and pacing lead or leads.

The pacemaker itself is a pulse generator consisting of miniaturized electronic circuitry and a compact battery. Modern pacemakers take action only in the absence of a natural heart rhythm.
Therefore, the pacemaker must be able to recognize or sense heart activity. When the pacemaker does not sense any intrinsic heartbeats, it releases an electric impulse. As a result, the heart muscle will contract. The pacemaker is connected to the heart through one or two leads.

A lead is a very thin, electrically isolated wire that is placed directly in the right ventricle or right atrium. Through the wire, the electrical impulse is transported to the heart. The lead can also sense heart activity and feed this information to the pacemaker.
Depending on the therapy required, single- or dual-chamber pacemakers can be used. These terms refer to the device’s capacity to pace or sense in one or both chambers. In a dual-chamber system, usually one lead is located in the atrium and the other in the ventricle. So signals can be sensed from both chambers, and either or both chambers can be paced to ensure an optimal muscle contraction. This approach is often referred to as synchronization between the two chambers.
Many pacemakers can automatically adapt their impulse rate to changing physiological conditions. These rate-adaptive features of the pacemaker are connected to a special sensor that looks for changing physical parameters within the body.

Changing physiological needs that occur during running, swimming or gardening, for example, are met by the pacemaker with an increase in heart rate.
Furthermore, the latest generation of BIOTRONIK pacemakers can also react to mental changes. Everybody has experienced a sudden rise in pulse or blood pressure while watching an exciting film or if an unexpected event occurs. CLOSED LOOP Stimulation, a special feature of this pacemaker type, can adapt the pacing rate to both physical activity and emotional stress. BIOTRONIK’s wide range of products allows the physician to appropriately diagnose and treat any rhythm disturbance. Due to extensive research, BIOTRONIK pacemakers today are not only technologically advanced but are also safer, smaller, lighter and more streamlined. Your physician will tell you which pacemaker type meets your needs best.
Due to today’s technology, pacemaker implantation has become much easier and safer. This common procedure often takes less than an hour. Usually, the physician locally anaesthetizes the region under your collarbone. Then the pacemaker lead is carefully inserted through a vein into the heart. Because blood vessels are not sensitive to pain, no extra anesthesia is needed. In general, X-ray monitoring is used for controlling the correct positioning of the lead within the right atrium or ventricle. Only after the functioning of the lead is tested will it be connected to the pacemaker. The pacemaker itself is implanted just under the skin in a small pocket below the collarbone. Finally, the physician closes the incision with a few stitches.
After the Implantation

Normally the recovery period is short. You may have a little soreness around the place where the pacemaker is implanted, and you might therefore be prescribed a pain-reliever. You may also need time to get used to the pacemaker in general. But this feeling of irritation will vanish after some time.

But you should notify your physician if:

<table>
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<th>The incision becomes red, hot or swollen or seeps fluid.</th>
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<td>You develop symptoms such as fever, dizziness, chest pain, or prolonged fatigue or weakness.</td>
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Additionally, during the first days after implantation, you should avoid fast or wide movements with the shoulder where the pacemaker is implanted. Short while after surgery you will have your first follow-up appointment with your physician.

Your electrical heart activity and the pacemaker functions will be tested. Often the pacemaker pro-
The advanced features of BIOTRONIK pacemakers can be adjusted externally and safely.

gramme will be adjusted to your individual needs. All the reprogramming is done by an external programmer, no further surgery is necessary. In most cases you will not even notice it.

On average, you will have regular follow-up exams. At every visit, the correct functioning, such as battery status or threshold, of your pacemaker will be tested. In general, you will be able to live a fulfilling life soon after implantation.
Adapting to a Life with a Pacemaker

Slowly, you are able to return to your daily routines.

→

Please follow these guidelines:

- Take the medication prescribed by your physician.
- Check your pulse regularly and keep track of changes.
- Attend your scheduled follow-up appointments.
- Always carry your pacemaker identification card with you whether at home or while travelling.
Arranging Your Daily Routine

With an implanted pacemaker, you will be able to lead a fulfilling life!

You may continue your usual activities, such as gardening, housework, and driving.

You may shower, bathe or swim.

After consulting with your physician, you may resume hobbies, sports or sexual activities. In any case, if you feel unsure or have any concerns, please contact your physician.
BIOTRONIK pacemakers are protected against the influence of electrical appliances. If you are near an electrical device and you notice symptoms (rapid heartbeat, irregular pulse or dizziness), move away from the device and/or switch it off immediately.

**You can still use:**

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<th>television, radios, stereos</th>
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<td>hair dryers, electrical shavers</td>
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<tr>
<td>washing machines, vacuum cleaners, microwave ovens</td>
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<tr>
<td>office equipment (computers, fax etc.)</td>
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<tr>
<td>all electrical appliances in the kitchen</td>
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Attention: please check that all electrical devices are in proper condition.
Normal telephone use is not restricted. Regarding mobile telephones, please talk to your physician. To avoid possible disturbances, telephone with the ear that is opposite to the side of your body where the pacemaker is implanted.

It is very important to check with your physician about these activities as well:

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<th>Activity</th>
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<td>working with heavy equipment with strong vibrations (drilling machinery, for example)</td>
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<tr>
<td>discharging firearms (hunting, for example)</td>
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<tr>
<td>electrical devices with strong electromagnetic fields or high voltage transmission lines</td>
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<td>electrical welders</td>
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In general, travel by airplane, boat or car is not a problem for people with a pacemaker. You may travel but please do check with your physician regarding any distance limitations.

When travelling, please notify your physician. He or she can provide you with the locations of clinics that are closest to your final destination.

If you are going by plane, inform the security staff and show your cardiac pacemaker identification card. The personnel will instruct you on what to do during the security check.

Travel by car is not a problem. For your own safety, please wear your seat belt always, your pacemaker will not be harmed.
Before you receive any treatment, please inform all physicians, dentists and physical therapists that you have a pacemaker.

> The following procedures are harmless:

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<th>Procedure</th>
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<tr>
<td>x-rays</td>
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<td>having your teeth drilled</td>
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Attention: In case of very special procedures such as radiation, lithotripsy, transcutaneous electrical nerve stimulation (TENS), magnetic resonance imaging or electrocautery a detailed analysis should be made beforehand in presence of your cardiologist.
Questions you always wanted to ask

→ Can I go through airport security systems or anti-theft detectors?
Yes. BIOTRONIK pacemakers are protected from the influence of external factors (for more information, please ask your physician). However, you must state that you have an implanted pacemaker, because the metal housing may set off the security alarm system. To be on the safe side, inform the airport personnel about your pacemaker and pass through the detector quickly.

→ Will I feel the pacemaker working?
No. The pacemaker functions at such a low level of electrical current that it only affects the heart and the surrounding tissue. However, should you experience any symptoms (such as frequent hiccups), please inform your physician.

→ How long does a pacemaker battery last?
The exact time for replacement depends on your pacemaker type, medical condition, lifestyle and other factors. In general, most pacemakers last for some years. Please ask your physician about your specific pacemaker type.
What happens when my pacemaker needs to be replaced?
The pacemaker is removed through minor surgery. The leads are left in the heart, provided they are functioning properly, and are connected to the new pacemaker. Usually a short hospital stay is necessary.

Will the leads also have to be replaced?
During pacemaker replacement, the doctor checks the leads to make sure that they are functioning properly. If they do not need changing, then they will be simply connected to the new pacemaker.

Will the pacemaker need adjusting after implantation?
Possibly. Depending on your medical condition and lifestyle, a slight readjustment may be necessary.

Will the pacemaker still be able to provide for me as the battery grows weaker?
Yes. Your physician can determine how much battery life remains at your regular follow-up appointments (please consult your physician for questions regarding your BIOTRONIK pacemaker).
→ **How does a heart and a pacemaker react in the case of passing away?**
A heart can only function when it is supplied with blood and energy. In the case of death, the small electrical impulses from the pacemaker will have no effect on the heart – just like a conductor cannot give a concert without an orchestra.

→ **Can I use a mobile telephone?**
Yes. You can use your mobile telephone safely, but some precautions should be taken: Please check with your physician for your specific situation.
Be sure not to place the telephone near the pacemaker site (such as in your breast pocket).
When phoning, hold the receiver to your ear that is on the opposite side of your body to the site of your pacemaker. Due to differences in telephone technology, please check with your physician.
How often do I have to see my physician for follow-up visits?
You physician will determine your particular follow-up schedule. In general, follow-up appointments are scheduled every 6–12 months.

Can I still use home electrical appliances such as microwaves, dryers, electric blankets, massagers?
The normally functioning home electrical appliances mentioned above will not damage your pacemaker. But be aware that appliance repair should always be done by an expert.

Will my body show allergic reactions to the pacemaker materials?
Normally not. BIOTRONIK uses only highly biocompatible materials such as titanium or medically proven plastics which do not react with bodily fluids.
Glossary of important terms

**Arrhythmia:** an abnormal rhythm of the heart or an irregular heartbeat.

**Asystole:** absence of a heartbeat, cardiac standstill.

**Atrium (plural: atria):** the upper chambers of the heart, the left atrium and the right atrium.

**AV node:** the atrioventricular node, the area of the heart which conducts the electrical signals to the ventricles.

**Block or heart block:** permanent or temporary impairment of normal impulse conduction within the heart.

**Bradycardia:** low heart rate, usually less than 60 beats per minute.

**Circuitry (electronic):** electronic components located inside the pacemaker which are responsible for the timing of electrical impulses sent through the lead into the heart.
Coronary arteries: the arteries which supply the heart with blood.

Dual-chamber pacemaker: a pacemaker which allows the coordination of atrial and ventricular impulses, making it very similar to the heart’s own activity. Usually two leads are required, one is placed in the right atrium and one is placed in the right ventricle.

Electrocardiogram: a graphic representation of the various electrical currents produced by the heart during a heartbeat, as well as the impulses produced by the pacemaker.

Endocardial lead: a lead which is placed within the heart muscle and lies usually within the right ventricle.

Epicardial lead: a lead which is attached to the outer surface of the heart.

Fibrillation: fast, uncoordinated contractions of single heart muscles.
**Lead:** the insulated wire or wires carrying electrical impulses between the pacemaker and the heart muscle. It also relays information about the heart’s own activity back to the pacemaker.

**Paced beat:** a heartbeat initiated by a pacemaker.

**Programmer:** a small computer which allows external communication with the pacemaker. This allows the monitoring of pacemaker activity, changing the pacemaker programme to adapt to your different needs, and ECG recording without external equipment.

**Pulse:** the rhythmic expansion of an artery as blood is pumped through it when the heart beats.

**Rate-responsive pacemaker:** a pacemaker that determines the body’s movements through the use of sensors. This information is then used to adapt the pacemaker’s reaction to the heartbeat which you need at that moment. Both single-chamber as well as dual-chamber pacemakers can be rate-responsive.
**Sinus node:** or sinoatrial (SA) node. The area of the heart in the right atrium responsible for the electrical impulses which result in a contraction or a heartbeat. Also known as the natural pacemaker.

**Sensing:** a pacemaker function which allows the pacemaker to recognize the heart's own activities. If the pacemaker senses a heartbeat, then it will not send an impulse. If it doesn’t, an electrical impulse is sent to cause a heartbeat.

**Systole:** the contraction of the heart which causes the blood to be transported through the body and to the organs.

**Tachycardia:** an abnormally high heart rate, usually more than 100 beats per minute. This quick pumping is usually inefficient, and the body’s demand for blood is not met.

**Ventricle:** the lower chambers of the heart. When these chambers contract or beat, the blood is pumped throughout the body and to the various organs.