



# The artificial shoulder joint

# Editorial

Dear reader

We have written this brochure for patients, family members and all those who wish to know more about the replacement of a shoulder joint. It is intended to answer basic questions, explain the principle and the procedure of implanting an artificial shoulder joint, and relieve any misgivings or fears that you may have. Please note that this information cannot replace a conversation with your doctor.

You are most likely reading this brochure because your attending physician has already diagnosed osteoarthritis of the shoulder joint in you or someone close to you. No doubt your doctor has prescribed other methods of treatment, such as drugs, physiotherapy or remedial gymnastics. And yet such methods cannot eliminate the pain and rarely have a long-term, lasting effect on advanced osteoarthritis.

Pain – especially chronic pain – from osteoarthritis of the shoulder joint can become a major problem, and may restrict both physical capacity and quality of life. In advanced osteoarthritis of the shoulder joint, a shoulder joint endoprosthesis – i. e. an artificial shoulder joint – can provide relief. Patients can in most cases recover their lost mobility and almost always freedom from pain and the resulting quality of life after such a surgery.



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# 1. The shoulder joint

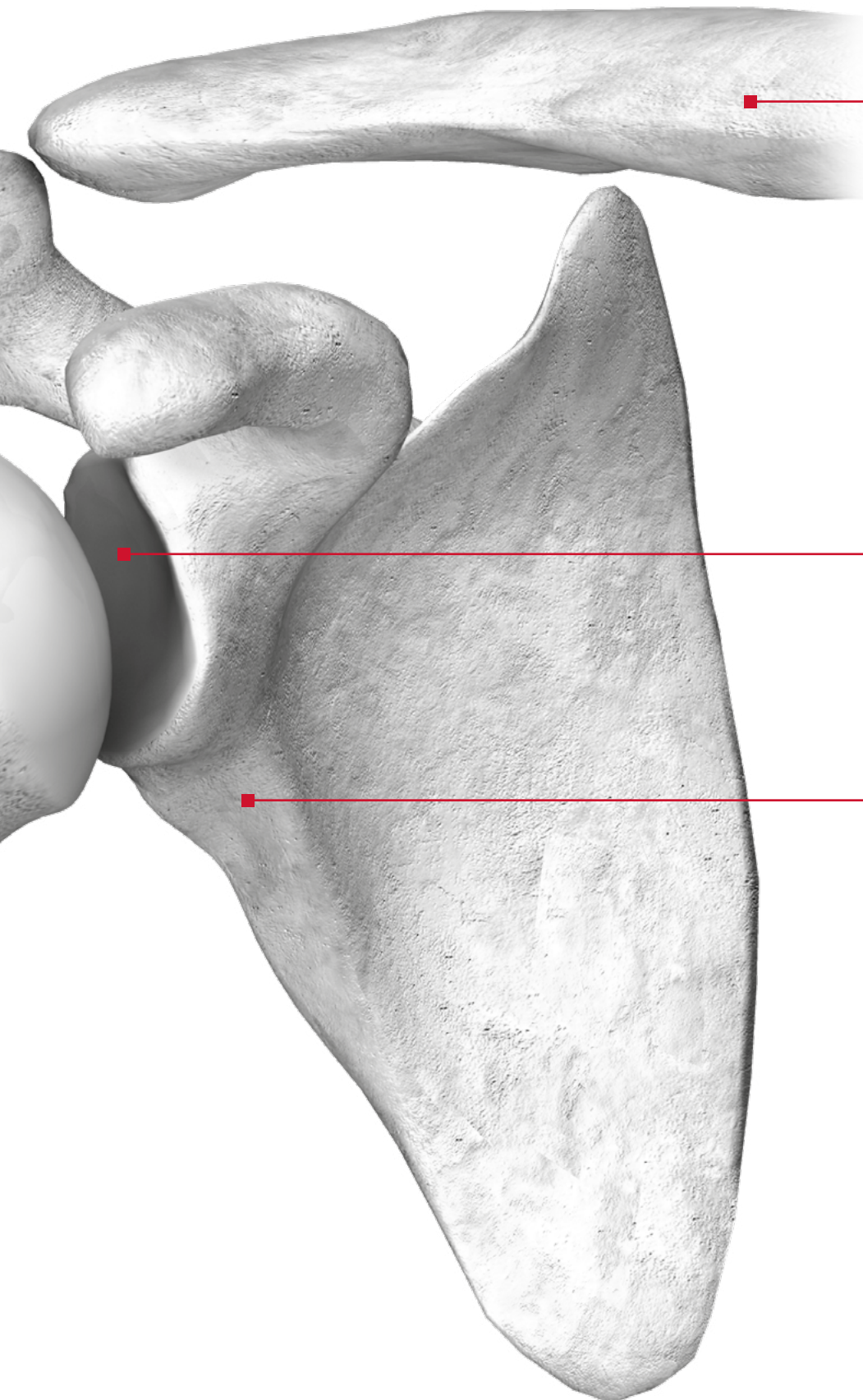
The shoulder joint is the most mobile joint in the body and yet at the same time is very easily injured. As a ball joint, it allows movement in all directions, letting us use our arms and hands in many different ways. The socket – also referred to as the glenoid – is part of the shoulder blade. Both the socket and the round head of the upper arm bone, which is the ball that lies in the shoulder socket, are coated with a layer of cartilage. A viscous fluid, the so-called «synovial fluid», is located between the two cartilage-covered joint surfaces. An elastic and aqueous tissue, the articular cartilage permits a low-friction gliding motion sequence. Strong ligaments, a joint capsule and the surrounding muscles ensure the stability of the joint.

An anatomical illustration of the shoulder joint, showing the head of the humerus (upper arm bone) resting in the glenoid socket of the scapula. The joint surfaces are covered in a layer of cartilage. Three red lines with small square markers point to the cartilaginous layer, the head of the humerus, and the upper arm bone (humerus).

Cartilaginous layer

Head of the humerus

Upper arm bone (humerus)

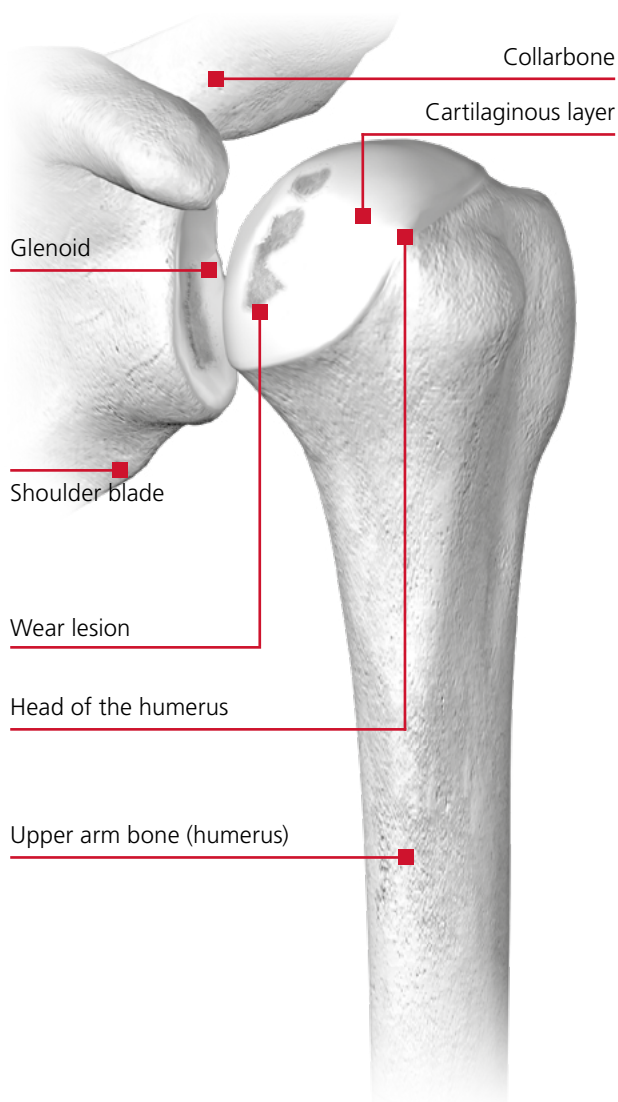


Collarbone

Socket (glenoid)

Shoulder blade

## 2. What is osteoarthritis?



Wear of the joint may lead to attrition of the articular cartilage, which is a natural symptom of old age. Unlike other types of tissue in the human body (such as the skin), articular cartilage is unable to heal or repair itself, and thus injured or worn articular cartilage is lost forever. This loss of the surface layer of the joint quickly leads to painful functional impairment.

The insidious arthrotic process often takes place over several years. Progressive death of cartilage cells (chondrocytes) results in grooves and fissures. As a consequence, the cartilage gets rougher and increasingly frayed under normal loading. Small cartilaginous debris can form, irritating the synovial membrane and causing joint inflammation as well as joint effusion. Mobility worsens steadily and the person concerned suffers from ever more severe pain.

In addition, the joint can build osteophytes as well as new bone. By increasing the bearing surface of the joint and limiting painful motion the body tries to prevent additional damage of the cartilage, but this process is not effective.

Pain is the main symptom or consequence of osteoarthritis. It occurs with any movement and later increasingly when at rest. The pain frequently causes the sufferer to relieve the joint. This in turn causes the condition of the cartilage, which needs movement for its nutrition, to deteriorate. There may also be a loss of muscle, which ultimately causes stiffening of the arm.

A common form of shoulder osteoarthritis is so-called primary osteoarthritis (joint wear of unknown cause). This is currently considered a typical symptom of old age.

Chronic polyarthritis (articular rheumatism), which frequently involves several joints, can cause the same problems, but with different causes. In a defensive reaction, the body develops substances that swell the synovial membrane and cause chronic inflammation of the joint with a progressive destruction process.



### 3. How does osteoarthritis occur?



The complex process of the formation of osteoarthritis has yet to be clarified. Orthopaedists and surgeons are able to treat the symptoms, but aetiological healing is not yet possible.

It is known that factors such as overloading or inappropriate straining of a joint, due for instance to a congenital malposition or frequent bearing of heavy loads, as well as injuries to the bone, cartilage, or ligament as a result of accidents, favour the formation of osteoarthritis. People who constantly and excessively overstrain their joints (such as those who do heavy underground work or competitive athletes etc.), are especially at risk.

The shoulder joint allows great freedom of movement, but that makes it much less stable than the hip joint, for example. Unstable joints may suffer from dislocations. Every injury of this kind represents a dysfunction in the system and can favour the formation of osteoarthritis. In principle, any disease of the articular cartilage, synovial membrane or synovial fluid can lead to osteoarthritis.





## 4. Other reasons for joint replacement

Compared to other joints – such as knee or hip –, the shoulder joint is less frequently affected by osteoarthritis. However, other incidents may necessitate implantation of an artificial shoulder joint:

### **Fracture**

Unlucky falls onto the shoulder can lead to fracture of the humeral head, of the humerus itself or of the bony protuberances in the shoulder joint. In such fractures, the humerus can be separated from the shoulder blade. In addition to pain and movement restrictions, the consequences include cartilage injuries.

For the treatment of such so-called comminuted fractures, a fracture endoprosthesis is used. This permits fixing bone particles (debris), replacing the damaged joint surfaces and restoring the function of the shoulder.

Information on the fracture endoprosthesis can be found on page 16 of this brochure.

### **Instability due to dislocation**

Instability in the shoulder joint is usually due to dislocation (luxation): By a fall or exposure to excessive, uncontrolled, passive external force, the communicating joint surfaces are shifted. Ligaments and joint capsules can tear; the joint head leaves the socket. Dislocations are usually accompanied by swelling and haematoma formation (bruising).

### **Failure of the rotator cuff**

The rotator cuff (also known as muscular ring) is a group of four muscles whose tendons surround the shoulder joint and stabilize it. Acute injury, such as from a fall, may lead to tearing of the tendons, called a rotator cuff rupture.

However, the most common cause of such an injury is erosion of the cuff, as it can occur in athletes or artisans due to the effects of excessive loads. The main cause for tendon lesions is wear due to age and a genetic predisposition. The hallmark of this condition is pain, which can occur for months or years at varying degrees of intensity.

Rotator cuff injuries are often treated with reverse endoprosthesis.

Information on the reverse endoprosthesis can be found on page 15 of this brochure.

## 5. Treatment methods

Use of a shoulder endoprosthesis is of course not the first step in treatment. Before implanting an artificial joint, doctors use other non-operative treatment methods to alleviate pain:

- Analgesic, anti-inflammatory drugs
- A change of habits (with regard to sports, posture etc.)
- Injections where appropriate
- The use of orthopaedic aids and splints
- Physiotherapy and remedial gymnastics

All these measures differ in efficacy from patient to patient. In many cases, actual alleviation of the complaints and restoration or improvement of mobility can be achieved only by an artificial joint replacement. It is crucial to find the right timing for the operation: If the osteoarthritis is already very advanced, the shoulder may already have stiffened and the socket could be destroyed. These circumstances may make surgery more difficult or even impossible and considerably reduce the success of the operation for those affected.

### **When surgery becomes an issue**

Surgery always means weighing benefits and risks. On the one hand, there are the general and specific risks involved in an operation (such as problems with the anaesthetic, post-operative bleeding, infection etc.), which your attending physician will explain to you in detail.

On the other hand, you can almost always assume freedom from pain and normally an obvious improvement in shoulder mobility.

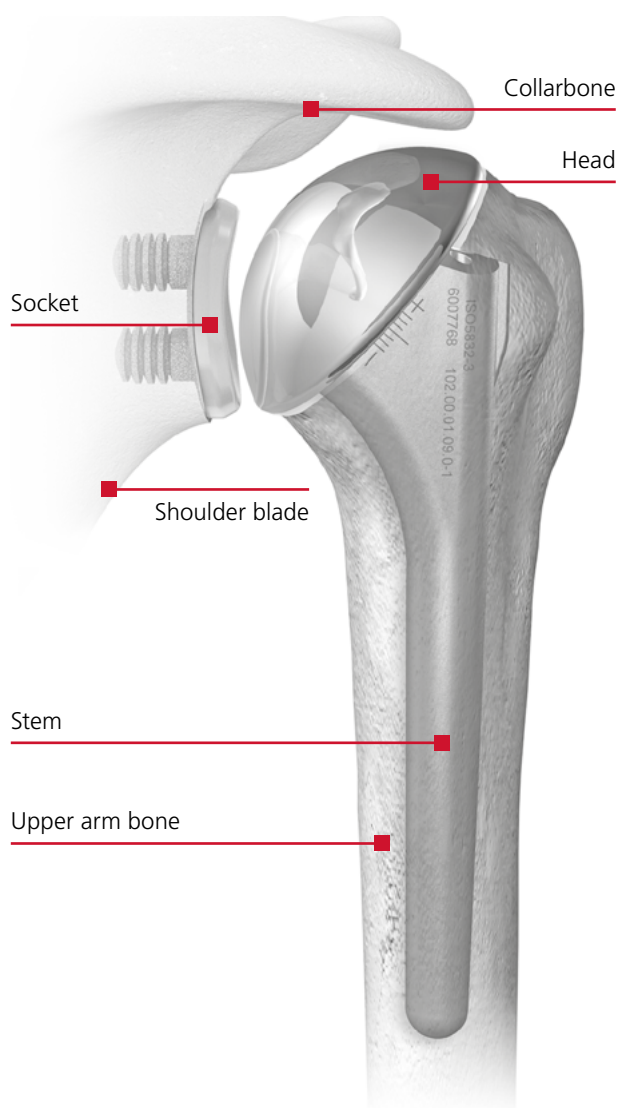
The slight risks of the operation are usually offset by the great improvement in quality of life. You must take the decision about an operation for yourself along with those close to you and in consultation with the attending physician.

## 6. The artificial shoulder joint

Implantation of a shoulder endoprosthesis aims at restoring freedom from pain as well as freedom of movement and lifting capacity. However, an artificial joint can never fully restore the natural joint function.

The physician will explain the surgery and course to you in advance. Furthermore, the type of endoprosthesis to be implanted will be explained. Depending on the type of disorder, activity level of the affected persons and bone quality, from among various implant models the most suitable one is selected and fixated accordingly in the bone.

Information about the most commonly used endoprosthesis types for shoulder joint replacement and their fields of application is provided on the following pages.



# The total endoprosthesis

The total endoprosthesis is used for complete joint replacement and is the classic treatment. Here all destroyed respectively worn-down joint surfaces are replaced.

It consists of the following three parts:

## **The socket**

The new shoulder socket – also referred to as the glenoid – is made out of a highly crosslinked polyethylene (HXLPE) enriched with vitamin E. It is anchored in the natural socket and completely replaces the surface.

## **The head**

The head of the endoprosthesis is made of metal (cobalt-chromium-molybdenum) and is between 39 and 53mm in diameter. It has a highly polished surface to allow it to move easily and with little friction in the new shoulder socket.

## **The stem**

The stem of the shoulder endoprosthesis (titanium) is anchored in the upper arm bone. There is a cone on the upper part of the stem, where the artificial head is fastened.

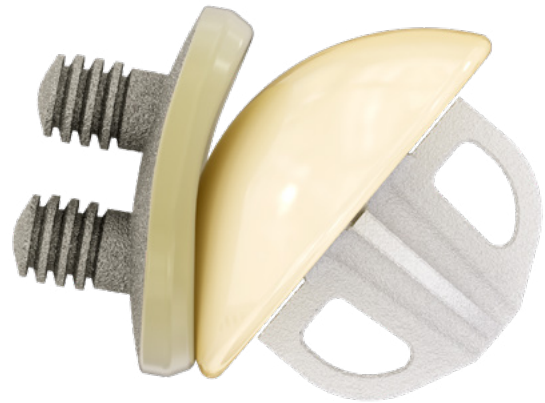


# The stemless endoprosthesis

The stemless endoprosthesis is likewise implanted as a total endoprosthesis, but with a much shorter stem. In case of good bone quality, it can be used as an alternative to the conventional total endoprosthesis.

Implantation of a stemless endoprosthesis offers various advantages, such as shorter operation times or reduced blood loss. In addition, in the upper arm more bone material is preserved, which can be very beneficial in case of possibly required replacement surgery (revision).

Stemless endoprosthesis are anchored without bone cement. In order to accelerate osseointegration, the stem is provided with a special coating; the head can be made of ceramic or metal; the glenoid consists of highly crosslinked polyethylene (HXLPE) enriched with vitamin E.



# The reverse endoprosthesis

In reverse endoprosthesis, ball and cup are reversed. I. e., the plastic ball is attached to the shoulder blade, the metal or ceramic cup to the humeral implant. Using the deltoid muscle, the arm can then be raised again even if the rotator cuff is defective.

This «inverted» endoprosthesis is used in case of:

- Large irreparable rotator cuff ruptures with weakness and movement restrictions of the shoulder
- Rotator cuff defect arthropathy (long-standing damage to the rotator cuff tendons leading to a particular form of osteoarthritis)
- Endoprosthesis replacement surgery (revision)

Since in these cases conventional joint replacement does not reliably lead to freedom from pain, and the loss of strength and restriction of movement cannot be overcome by the standard endoprosthesis, in many cases reverse joint replacements are used.

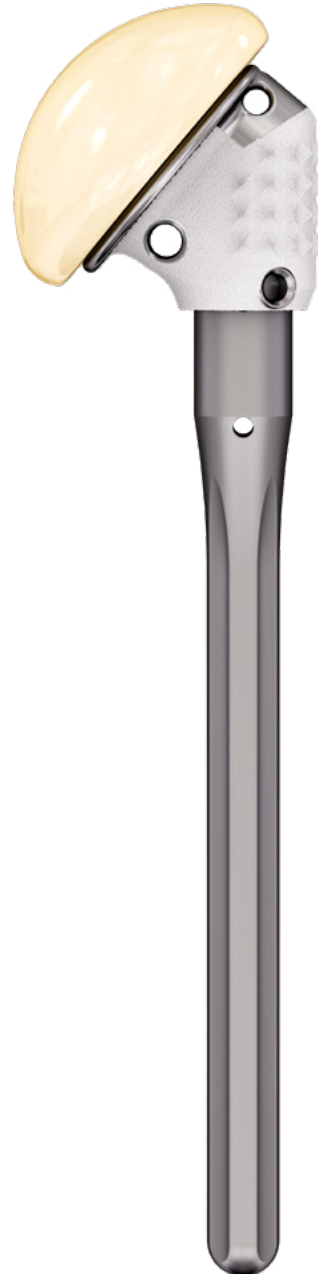


# The fracture endoprosthesis

The humeral head is prone to complicated fracture injuries: A fall onto the hand, the out-stretched arm or the shoulder itself can result in a complex fracture.

In such complicated injuries, fracture endoprosthesis are often used. Their design allows secure fixation of the fractured pieces of bone with the rotator cuff tendons using threads or medical wires.

This creates the prerequisites for being able to move the injured shoulder painlessly and active again. However, patients do not always get back the habitual range of motion and may be faced with restrictions of the shoulder joint.





# The reverse fracture endoprosthesis

In some fractures, the so-called rotator cuff can be affected: It is formed by four muscles that surround the joint like a sleeve, substantially contributing to its stabilisation.

In cases where both a fracture and a defect of the rotator cuff are present, an reverse fracture endoprosthesis can be used. This implant combines the advantages of the reverse and fracture endoprosthesis. Its design allows better freedom of movement than possible with regular fracture endoprosthesis, while simultaneously splintered bone chips can be securely fixed.

The reverse fracture endoprosthesis can also be used as a revision implant: Fractures treated using regular fracture endoprosthesis may not heal as expected and adversely affect the rotator cuff. Then it is possible to produce relief by means of a reverse fracture endoprosthesis, with the objective of improved freedom of movement and alleviation of pain.



## 7. Prior to the hospital

In the first days and weeks after the hospital stay, you will have to face various challenges.

### You can prepare your home optimally for the time after the operation:

- Place objects you use daily (tableware, clothes, drugs, etc.) at hip height. We recommend a trolley to transport meals.
- Place various aids in the bathroom: Hand-holds, a non-skid shower mat, and a sponge on a long handle for daily personal hygiene.
- Aids for dressing and reaching, such as grabbers, stocking pullers, etc. are available in medical supply shops. Inquire about what might be useful or necessary before your hospital stay.
- Place an electric torch close to your bed, if you cannot activate the light switch from there. That will prevent you from tripping over things when you have to get up at night.
- Prepare your food by deep-freezing it so that you need only heat it up later. You can save yourself a lot of kitchen work in the first days.

## 8. What happens at the hospital?

You will be examined thoroughly before the operation. This will help to identify any possible risks early on and allow medical staff to take the necessary prophylactic measures. Your doctor will inform you about drugs and anaesthetics.

### Your examination may include the following questions and items of information:

- Do you suffer from cardiovascular problems or high blood pressure? If so, are your medications well regulated? The nursing staff will measure them and possibly conduct an ECG.
- Do you have an infection? Or if you suffer from diabetes, how well does your therapy work? A blood sample may be taken before the operation to clarify these questions.
- Smoking is a general risk factor – you might like to take the operation as an opportunity to quit. Smoker counselling is available in the hospital.
- Do you take anticoagulant or platelet-inhibiting drugs? If so, they will be stopped approximately ten days before the operation after consulting your general practitioner and, if necessary, you will receive a substitute by injection.
- The anaesthetist will inform you about the best form of anaesthesia for you.
- You will always have the opportunity to pose your own questions to the operating surgeon or to a ward physician.

## 9. The operation

The operating method is similar for most shoulder endoprosthesis: The diseased bone and tissue parts are removed and the remaining bone is shaped with the operating instruments to allow the endoprosthesis components to fit exactly and be affixed.

### The operation comprises the following four steps:



The shoulder joint is prepared for the endoprosthesis; the defect is clearly visible.

#### Step 1

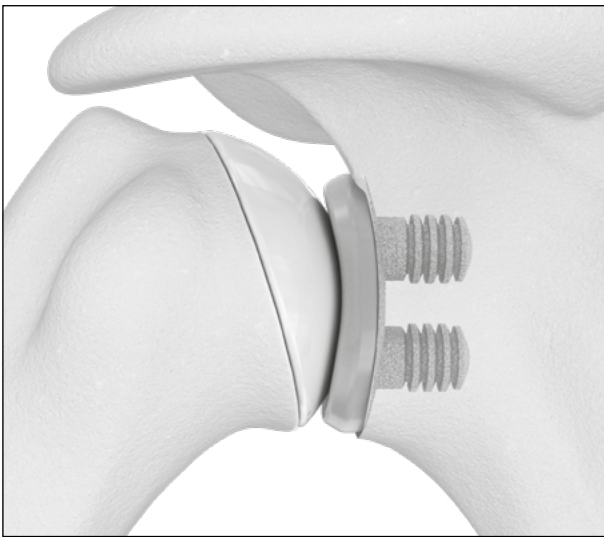
The surgeon accesses the shoulder joint by making an incision in the skin of the shoulder. The diseased joint is revealed after opening and partial removal of the joint capsule. A mill saw is used to separate and remove the head from the upper arm bone. The socket is now clearly visible. Old capsular tissue and cartilage are removed from it and it is prepared using a cutter so that healthy bone tissue is visible. This ensures secure anchoring of the artificial socket.



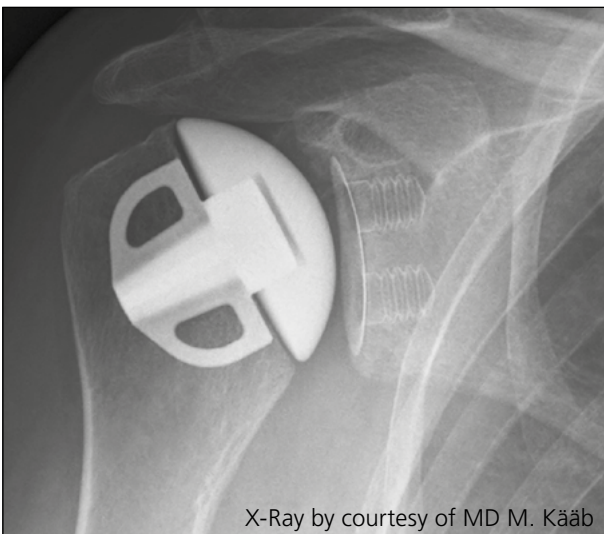
The glenoid is anchored in the socket; the stem is introduced into the prepared upper arm and perhaps fixed with bone cement.

#### Step 2

The surgeon prepares the interior cavity of the upper arm bone (medullary space) for implantation of the stem. Bone cement may be used to anchor the stem, depending on the situation. This decision primarily depends on the quality of the bone and the patient's age. There is no difference in the quality of care. The bone cement is very compatible and hardens fully in a few minutes.



The three individual components of the endoprosthesis are put into place; the shoulder is functional again.



X-Ray by courtesy of MD M. Kääh

X-ray check of the implant following a successful operation.

### Step 3

After the socket is fastened in the bone, the surgeon anchors the stem with the head of the endoprosthesis in the upper arm bone before resetting the joint. That completes the movable connection between the stem and the socket. A final functional check of the joint is done by moving it in all directions.

### Step 4

Finally, the incised tendons are reattached and the surgeon stanches any existing haemorrhages. Tubes are inserted into the wound to drain off the bleeding. The surgeon sutures the joint layer by layer before applying a compression dressing.

## 10. Risks and complications

Your surgeon is obliged to inform you about all circumstances that are essential for your consent. This includes in particular about the type of treatment, the expected consequences and possible risks of the surgery as well as its necessity, urgency, suitability and prospects of success with regard to the diagnosis or therapy. The surgeon will also discuss with you about alternative treatment options. If you have any unanswered questions or are unsure about the risks of the treatment or undesirable effects, please contact your doctor.

**The following factors may prevent a successful implantation or recovery from your surgical treatment:**

- Intense physical activities
- You do not follow directions from your doctor
- Severe deformities
- Metabolic disorders
- Generally weakened immune system
- Drug or alcohol abuse
- Neuromuscular or mental disorder
- Obesity

**If you suffer from any of these factors, your surgeon will discuss them with you and work with you to find the best treatment option.**

**Strictly speaking**, every operation involves both general and specific risks. The surgical team always endeavours to treat you in the best possible way and to avoid any complication.

Please inform your surgeon or hospital immediately if you experience any undesirable effects.

## 11. After the operation

Normally, the drains remain in the shoulder joint for one to two days, until the last haemorrhage trickles have ceased. This prevents the formation of haematomas that can restrict mobility. If there is minimal bleeding intraoperatively, sometimes drains are not used.

Generally, physiotherapy is started on the very first day after surgery. A physiotherapist will guide you and practise daily with you. These exercises will help your shoulder joint regain good mobility as rapidly as possible. The controlled movement and partial load on the operated shoulder over the following (four to) six weeks help the tissue layers of the shoulder joint heal. You may receive analgesic medications (painkillers) for a few more days and daily injections or tablets of anticoagulants (blood-thinning drugs) for thromboprophylaxis (prevention of excessive blood clotting) in the hospital.

About a week after the operation, you will be discharged, either to your home or to a rehabilitation centre. Your sutures can be removed as early as two weeks after the operation.

### **Abide by the following precautionary measures to promote healing and avoid unnecessary risk to the healing process:**

- Your doctor will discuss your individual follow-up treatment with you and may also give you a post-operative treatment plan. You should carefully read it and give it to the physiotherapist who provides further treatment.
- In principle, you should continue to treat your shoulder gently for the first four to six weeks following the operation – but be absolutely sure to do the recommended movements!
- To protect the sutures in the tendons of the shoulder joint, do not make any outward rotational movements for up to six weeks following surgery. Generally speaking, you will have to wear a shoulder immobiliser for the first few days or weeks.
- Do not carry excessively heavy objects for the first six to twelve weeks!
- Shoulder movements must be intensified at the latest six weeks after the operation; normally there are no further restrictions after this time.
- During the three to six months following the operation, you will have to do exercises, either alone or with a physiotherapist. Make sure to keep your operated shoulder moving every day!
- Avoid excessive loads in your everyday life (such as heavy physical work) and risky situations (climbing a ladder, etc.).

## 12. The follow-up treatment

Regular controls by a medical specialist are important and help to monitor the healing process. Coordinate the procedure in detail with your physician. If between or after the controls any complaints should occur, please contact your physician immediately.

It is quite normal to experience some limitations up to a year after the operation – improvement and adaptation occur gradually, but steadily.

You will generally have regained most of your mobility by three or four months after surgery. You should get any assistance you need in the household or for shopping. If you live alone you can enlist the aid of a nursing service. The hospital will inform you about the various services on offer.



## 13. Sports

We recommend physical exercise, as it upgrades the quality of your social and physical life and prevents illness.

Aspire to good mobility and increased muscle strength following the insertion of a shoulder endoprosthesis. Well-developed musculature of the upper arm and back stabilises the shoulder joint considerably.

It is important that you increase your physical load appropriately and that you take pain seriously as a warning sign. It is generally accepted that a lack of exercise has a negative influence on an artificial shoulder joint.

Perhaps you were already involved in sports activities before the operation. If so, your physician can tell you whether you should continue with them now that you have a endoprosthesis. You should in any case abstain from sports which place inordinate stress on joints, or which pose a high risk of injury (such as football, martial arts, tennis etc.). As a general guideline you should not carry more than 5 kg with the involved arm.

Your safety is the top priority! Joint injuries and fractures in persons who have a endoprosthesis often have serious consequences. Train yourself to move somewhat more slowly and prepare for a gentler sequence of movements. You may still do Nordic walking and gymnastics, go bowling, biking etc., and play team sports, but with restrictions. In case of doubt, please ask your specialist.

**Always keep in mind that your new freedom from pain can quickly lead to an overload!**

# 14. The International Implant Card

You will receive an International Implant Card when you leave the hospital. It can be helpful in case of injuries of the joint or complications outside of your usual surroundings (on vacation or at airport controls, for instance).



## 15. Frequently asked questions

On the following pages, you will find the answers to questions frequently asked by patients. Some of the answers may be of assistance to you.

**How long does the operation take?**

The implantation of artificial shoulder joints is a routine intervention and takes around two to three hours.

**How long do I have to stay at the hospital?**

The duration of your stay depends for the most part on your general state of health. Your doctor will be able to inform you more precisely.

**How long will I be unable to work?**

Discharge from hospital is in some extent followed by a stay at a rehabilitation centre which begins immediately or, even better, after four to six weeks have passed. After that, your physical strain will be restricted for approximately another four to six weeks. You should use this time for further remedial gymnastics.

You will be allowed to use your hand early after the operation, if you keep your elbow close to your trunk. If you have a job, the resumption of your professional activities will depend on your daily physical stress. You will be fit for work sooner if you work in an office than if you do heavy physical labour. In that case you should anticipate a break lasting about three months.

**How long does the implant last?**

The physical strain, your age, the quality of your bones, and your lifestyle may have an influence on the longevity of the artificial joint. The expected lifetime is 20 years for anatomical total shoulder procedures and 10 years for reverse, fracture and revision shoulder procedures.

**I occasionally have an allergic reaction to metal. Is this a problem?**

Inform your doctor of your allergies to specific metals. If available, provide the doctor with your allergy passport. The materials we use for the implants and the coatings very rarely cause an allergic reaction. Special solutions are required in only a few cases.

**I feel very well after the operation – do I have to go to the follow-ups anyway?**

You should observe your follow-up dates without fail, even if you are not in pain and feel well. They allow your specialist to keep track of your rehabilitation and to recognise complications early on. In the first year after the operation, several follow-up examinations will take place. Later, these examinations will be required only once a year, then every two to three years. Your doctor will determine the ideal interval.

**I am in great pain – yet I was told to wait with the implantation of an artificial joint. Is this correct?**

Although it is ultimately up to the patient whether and when to have an endoprosthesis implanted, the decision should be taken in consultation with a specialist. Don't hesitate to ask him about his experience (for example, how many shoulder endoprosthesis he has implanted). The essential factors that influence a decision in favour of or against surgery are as follows:

- In your medical checkups and x-ray pictures, your specialist has found advanced osteoarthritis of the shoulder.
- Pain interferes so much with your quality of life that you are no longer able to cope with the daily routine without daily and permanent discomfort.
- Alternative treatment methods (e.g. physiotherapy) are no longer effective.
- You depend on a constant intake of drugs. These are no longer sufficient despite increased dosage.

If these factors apply to you, an operation should be considered regardless of your age.

If the above circumstances do not apply to you, it is advisable to postpone an operation and to look for further non-operative treatment methods.

**Which risks does the implantation of an endoprosthesis involve?**

Risks of such things as haematomas, drug allergies, thromboses, embolisms, infections or the risks mentioned on page 22 cannot be fully excluded, although they tend to be rare.

Preventive measures, such as the administration of drugs and physiotherapy, limit these risks to a large extent. Your doctor will provide you with exhaustive information on the subject.

**Do I need blood conserves during the operation or immediately after it?**

Nowadays, blood conserves are used only if the patient loses a large amount of blood during the operation.

**How do I proceed if I wish to donate my own blood?**

Currently, the majority of clinics can collect wound blood from the drains, clean it in a special machine and re-administer it to patients. Therefore, the donation of one's own blood is not performed anymore.

**Is my implant safe to MRI procedures using MRI systems?**

If you have an endoprosthesis and need to undergo an MRI procedure, please talk to your doctor and present the International Implant Card. Your doctor can provide you with the relevant information from the corresponding instruction for use on the MR safety of your implant and whether it is compatible with the MRI system.

It is also important to inform any staff at the radiological institute where the MRI procedure will take place about your implant. This will allow them to take any necessary precautions to ensure your safety during the procedure.

**Is my implant compatible with scanners used for security controls?**

In general, joint implants can trigger the alarm of security scanners. If you are concerned about the compatibility of your implant with security scanners, you should discuss this with your doctor, who can provide you with specific information about the type of implant you have and whether it is likely to set off metal detectors. Furthermore, your surgeon will provide you with the International Implant Card that explains the presence of your implant. This can help to expedite the security screening process and ensure that you are not inconvenienced during travel or other activities.

**When will I be able to drive a car again?**

You should only get behind the wheel when you feel fit to drive. You are the one responsible for this! We recommend that you consult with your attending specialist first. Most patients are fit to drive after two to three months, but this can vary widely from patient to patient. Never drive under the influence of strong pain relievers!

## 16. Epilogue

Along with the practitioners of the medical arts, you are responsible for your artificial shoulder joint and can contribute a great deal to your therapeutic success. Your cooperation is of the utmost importance. We hope that this brochure has explained the most important factors and procedures. Visit [www.mathysmedical.com](http://www.mathysmedical.com) for additional interesting and useful information. You should ask your attending physician any further questions.



# Aftercare appointments

Date & Time	Note

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