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Introduction

Humeral Head Surface Replacement, Cemented

The Durom Shoulder Cup Prosthesis is restricted to the replacement of the humeral head surface. The concept is intellectually based, on the one hand, on resection-interposition arthroplasty, in that a thin metal cap is chosen as an interposing component. On the other hand, it can be understood as a miniaturisation of the stem type of prosthesis.

In the development of the system, the principal aim was to reconstruct the humeral head surface in order to keep the extent of the bone resection to the minimum and, for young patients, to ensure an uncomplicated removal procedure after the long working life of the prosthesis. The prosthesis was developed as a hemiarthroplasty.

Decisive for the success of the prosthesis is the handling of the periarticular tissue during the operation. No less important is the reliable, anatomically correct positioning of the prosthesis. It is mainly these two aspects that are considered in the surgical instructions presented here.
Indications and Contraindications

Extensive and sound retention of the humeral head is necessary for the use of the Durom Shoulder Cup.

**Indications**
- Avascular necrosis (AVN)
- Osteoarthritis
- Rheumatoid arthritis

**Contraindications**
- Infections
- Pronounced osteopathies (i.e. HPT, renal osteodystrophy)
- Severe destruction of the humeral head
Description of the Implants

The Durom Shoulder Cup is made from hot-forged Protasul® S-30 alloy (FeCrNiMnMoNbN, ISO 5832-9). This material is highly resistant to corrosion. To achieve better bonding with the bone cement, the inner surface of the cup is rough-blasted.

The sphere of the cup is formed to the anatomical shape of the head of the humerus. The cylindrical flange at the equator ensures good anchorage. It is available in seven sizes. Sizing is based on the cylindrical flange and is available in seven sizes from 40 mm to 52 mm in 2 mm increments.

Ideally, the thickness of the cement jacket is 1 mm. At the edge of the cup there are radially protruding areas which serve to centre the cup and which lie against the reamed bone.

In the centre of the cup is a cylindrical lug, which serves to centre the implant during impaction and to prevent the cup from tilting on the spherically milled humeral head. The central drill hole pierced through its axis with a Kirschner wire allows the controlled implantation of the cup.
Preoperative Planning

For planning the operation, four X-ray pictures should be available:

- A/P image with internal rotation of the arm
- A/P image with 45° tilting of the tube and with the arm in the neutral position (the so-called “true A/P” image)
- Axial image
- So-called Y image

As a rule, computed tomograms or magnetic resonance imaging is necessary in order to assess the condition of the humeral head and the glenoid cavity.

True A/P imaging determines the size of the cup. The humeral cortex should not be completely removed. In a normal situation, the prosthesis axis and the humeral axis form an angle of 135°. The cranial limit of the cup should not be more than 5 mm above the tip of the greater tubercle.

For the implantation of the Durom Shoulder Cup, the instrument set that has been specially developed for this purpose must be used. It ensures the precise performance of the most important steps of the operation, which are essential for the reliable, anatomically correct positioning of the prosthesis.
Surgical Technique

Positioning of the Patient
The patient is placed in a half-sitting position at the edge of the operating table. If the upper part of the body is too upright, humeral head exposure can be jeopardized. By placing a pillow beneath it, the thoracic half of the upper part of the body is raised up a little. The head is fixed in a positioning head-rest. The arm must be mobile and, in particular, unrestricted backward extension and internal rotation must be possible.

Examination under Anaesthesia
The preoperative mobility test under anaesthesia makes it possible to detect contractures that have to be taken into account during the surgical procedure (e.g. subscapularplasty).

Approach
The incision is made in a straight line from the lateral part of the clavicle, through the coracoid process to the insertion of the deltoid muscle.

The cephalic vein is sought between the deltoid muscle and the greater pectoral muscle and held aside laterally with the deltoid muscle or medially with the greater pectoral muscle.

After entry between the deltoid muscle and the greater pectoral muscle, the tendon of the greater pectoral muscle is notched with the electrocauterizer. This step facilitates the exposure of the humerus and the glenoid cavity.
The clavicopectoral fascia is incised laterally to the biceps tendon and the tendon of the coracobrachial muscle. The tendons are held aside medially.

If there is no scarring and the external rotation are normal, the subscapular tendon and the capsule are incised vertically, 1.5 cm from their insertion on the lesser tubercle. As a variant, the tendon of the subscapular muscle may be released from the lesser tubercle either subperiosteally or with a rasp, and refixed transosseally at the end of the operation.

The coracoacromial ligament is incised and partly resected.

The rotator cuff is inserted between the tendon of the supraspinatous muscle and the subscapularis muscle, following the biceps tendon as far as the end of the glenoid cavity. In this case, the subscapular tendon is released from the lesser tubercle beneath the perios- teum or with a rasp.

The capsule is further incised caudally and the head of the humerus is dislocated forwards and upwards by maximum external rotation.
Setting the Retroversion
The usual retroversion of the head of the humerus is from 28 to 45 degrees.

The drill guide leads to an angle of 135° between the axis of the prosthesis and the axis of the shaft. In many cases it can be useful to deviate from this prescribed angle. The alignment of the drill guide then has to be adjusted accordingly. The retroversion can be set on the drill guide in 5-degree steps. As a rule, a retroversion of 35° is chosen. For the alignment in the operation site, the forearm is at right angles at the elbow.

The positioning guide, which at the same time serves as drill gauge, is mounted and aligned to the humerus. A 2.5mm thick Kirschner wire is drilled into the lateral cortex of the humerus. With the protection of the touch of the finger, the cortex should be just perforated.

The correct placement of the Kirschner wire is extremely important, as it serves as a reamer gauge, drill gauge and prosthesis-insertion gauge. Corrections to the wire placement should be made before the cortex is perforated, in order not to impair the stable seating of the wire due to repeated drilling.

The drill guide is removed.

Choice of Cup Size
Any osteophytes must be completely removed, as they distort the geometry of the head of the humerus. Synovitic tissue and cartilagenous residues are completely removed with the gouge forceps. Any bone defects must be spooned out. In case of AVN, the necrosed bone and fibrous tissue must be carefully cleaned out. After this step, the shape and condition of the head of the humerus can be properly assessed. Small bone lesions can be filled with autologous bone.
The diameter of the reamer is selected so that in the area of the equator about 1 to 2 mm of bone substance is removed. In case of doubt, a test should first be carried out with a reamer of larger diameter. The preoperative planning makes it easier to choose the right size.

Reaming
The reamer that has been chosen is pushed forward at a measured speed, the Kirschner wire serving as the guide. Both in the area of the equator and in the area of the humeral head pole, the cartilage must be completely removed, but the subchondral bone should be largely retained.

Under no circumstances must the reamer penetrate so far that the tubercle or the biceps tendon are damaged. It should be avoided to ream the cortical bone of the shaft.

Central Drill Hole
After processing the bone bed, a central hole is drilled over the Kirschner wire. The depth of the hole can be read from a step-scale (sizes 44, 46, 48, 50, 52) or from the markings (sizes 40 and 42).

Test
The insertion instrument is screwed onto the test prosthesis, which is placed in position over the Kirschner wire and is fit exactly on the bone bed. This process guarantees an optimally even cement jacket thickness for the implant, which has a larger internal geometry!

The depth of the implant seating is recommended to be marked with a pin (e.g., with a short (60 mm) Kirschner wire).
**Cementing**
First remove the long guiding Kirschner wire (1.).

The central lug of the prosthesis sits firmly in the drill hole. While impacting, ensuring that the cup is applied in the correct axis is essential. Before application of the cup, low-viscosity (!) cement is applied into the cup of the prosthesis. The stem of the prosthesis is kept free from cement. Using the spacer in the area of the equator of the prosthesis, an even cement jacket of 1 mm thickness is obtained.

Important: Removal of the short (60 mm) Kirschner wire is essential before the cement hardens.

**Closing the Wound**
After reduction of the joint, the subscapularis tendon is sutured end-to-end, with strong thread, ideally in an external rotation of 30° to 40°. If necessary, a z-shaped elongation of the tendon is made by means of capsule flaps. The rotator-muscle interval is closed with absorbable thread. At this time the rotator cuff is reconstructed, if necessary.

The wound is thoroughly rinsed; articular and extra-articular suction drainage is installed for 48 hours; an adapting suture of the deltoïd-pectoral sulcus is made, then intracutaneous closure of the skin; finally, a bandage is fixed on the arm with adduction and internal rotation of the shoulder joint.
Postoperative Therapy and Special Aspects

When the patient is in bed, a cushion placed under the elbow prevents the arm from passively falling into extension.

Active mobility exercises for the elbow joint and the hand are started on the first day after the operation. The extent of the passive movement can be rapidly increased. For the flexion exercises, a cord passed over a roll, which is moved with the healthy arm, is helpful. As a rule, the passive external rotation is restricted to 20° for 14 days, unless special conditions require greater restriction. Active mobility exercises can be started from the third week.

Especially during the first four weeks, exercising several times a day is important in order to achieve good mobility.

Special Aspects

During the discussion with the patient, preoperatively, the possibility that a stemmed prosthesis might be necessary, if the site of the operation does not allow the use of a cup prosthesis should be clearly stated.

If the patient presents with concomitant irreparable massive rotator cuff rupture, valgus implantation of the cup is recommended to facilitate articulation with the vault of the shoulder joint.

Literature

## Instruments

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Implants

Durom® Shoulder Cup humeral head surface replacement

Protasul® S-30 (FeCrNiMnMoNbN, ISO 5832-9)
Sterile packed, for cemented application

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