Joint action improves mobility.

PROMOS®
Modular Shoulder System
Surgical Technique
The following surgical technique for the PROMOS™ modular shoulder system is a general guide to the instrumentation specific to this system. It is expected that the surgeon is already familiar with total shoulder arthroplasty. Modifications to the surgical technique may be required based upon individual patient anatomy as dictated by the surgeon’s experience and judgment. Federal (United States) Law restricts device to sale by or on the order of a physician only.
The modular versatility of the PROMOS® creates a specialized implant to match each patient’s anatomical requirements, and the PROMOS® stem design is based on the proven philosophy of diaphysial anchorage. The bi-conical stem allows high primary stability and the rectangular cross-section ensures rotational stability.

Assembly of the modular components is performed, in situ, step by step, facilitating anatomical adaptability. For this purpose the following components are available:

- 10 cementless modular stem sizes and 1 monoblock option available in 3 heights for optimal humeral anchorage
- 3 bodies for adjustment of prosthesis height
- 4 lengths of inclination sets with ±12° infinite adjustment of inclination and version
- 14 eccentric humeral heads for adjusting head center to stem axis
- 15 glenoid implants, 4 sizes and 3 radii within each size for a defined translation of the prosthesis head in the joint

There is complete compatibility between the individual, modular components. All the modular humeral components are interchangeable with one another. The defined mismatch between the glenoid and humeral head recreates normal kinematics by permitting rotational and translational movement of the humeral head.

For controlled successful implantation of the PROMOS® shoulder, the correct indication, patient positioning, approach, soft tissue management, anatomical resection, and the processing of the bone structures, taking osteophytes into consideration, must be carefully followed.

The surgical technique is simple and structured in logical steps. In order to achieve an optimum outcome, the sequence should be observed. The instructions that follow should be read before using the system.

The modular PROMOS® shoulder system is implanted without cement on the humeral side and with cement on the glenoid side.

1. Introduction
2. Indications, Contraindications and Risk Factors

The therapeutic goals of implanting an anatomical total shoulder prosthesis are to reduce pain and/or bring about a functional improvement of the shoulder.

**Indications**

The PROMOS® Modular Shoulder is indicated for:

- Advanced degeneration of the shoulder joint as a result of degenerative, post-traumatic or inflammatory arthritis
- Avascular necrosis of the humeral head
- Complex fractures of the proximal humerus
- Functional impairment especially in the case of post-traumatic loss of the joint configuration

The humeral component is intended for cementless* use. The glenoid component is for use with bone cement only.

*only the cementless humeral component is available in the U.S.

**Contraindications**

- Acute or chronic infections, local or systemic
- Infected area of operation
- Severe muscle, nerve or vascular diseases of the shoulder
- Lacking bone substance or inadequate bone quality that endangers a stable seating of the prosthesis
- All concomitant diseases that may endanger the function of the implant, such as:
  - Any allergies to implant materials
  - High renal insufficiency
  - High cardiac insufficiency (e.g. as a result of increased metal/ions concentration in the blood)
- Pregnancy
- Neuropathic arthropathy (Charcot Shoulder)
Risk factors

These factors can influence the success of the operation:

- Osteoporosis
- Osteomalacia
- Severe deformations
- Generally weakened patient resistance (HIV, tumors, infections)
- Systemic diseases and metabolic disorders
- History of infections
- History of falls
- Drug, nicotine, alcohol or medication abuse
- Severe obesity
- Severe spasticity, Rigor, Tremor (e.g. M. Parkinson)
- Active sports and heavy labour
- Thrombosis or pulmonary embolism during the operation caused by preparing the implant bed or inserting the implant
- Postoperative morphological changes in the patient with weakening of the load bearing structures (e.g. tumors, hypertrophy, etc.) and/or changes in the material used (e.g. attrition or fracture of the cement bed and/or tissue reactions to the implant) can lead to the following implant failures:
  - Loosening, bending, crack formation or fracture of the components, the bone or the cement (if applicable)
  - Wear and loosening of the implant can make it necessary to reoperate on the artificial joint

Possible Side Effects

The complication listed below are among the most common adverse events resulting from shoulder arthroplasty:

- Dislocation, subluxation, insufficient range of movement, overstuffing or instability of the shoulder
- Infection
- Nerve lesion (Axillary nerve, brachial plexus)
- Pain
- Venous thrombosis and pulmonary embolism
- Cardiovascular or pulmonary (e.g. fat embolism) dysfunction
- Hematoma, wound hematoma and delayed wound healing
- Bone fractures resulting from unilateral strain or weakened bone substance
- Abnormal bending, loosening and reposition of the implant
- Abrasion of implant surfaces and development of osteolysis as a reaction to foreign bodies
- Fracture of the implant, bone or cement
3. Case Studies

**Primary Osteoarthritis**
Advanced concentric osteoarthritis with considerable painful restricted movement in a 72 year-old male patient.

**Rheumatoid Arthritis**
Shoulder destruction in rheumatoid arthritis.
Revision of Shoulder Prostheses
62 year-old female polyarthritis patient with aseptic loosening of the humeral and glenoid components after total shoulder arthroplasty in 1990. Excellent functional outcome 6 months after shoulder reconstruction due to a change of prosthesis.
Secondary Omartrosis
Idiopathic avascular humeral head necrosis with secondary degeneration of the joint and painful functional impairment.

Fractures of the proximal humerus
Humeral head multi-fragment fracture with head split.
4. Preoperative Planning

There are implant templates available at 110% magnification. This magnification is in accordance with the customary radiological enlargement for preoperative planning.

The radiographic template for the humeral head component, adjusted for the correct size, is laid over the X-ray image to coincide with the position of the anatomical neck. In this way the resection level is established according to the anatomy and marked if necessary. Then, using the head templates, the correct humeral head radius can be selected precisely with the appropriate humeral head height. Care must be taken to ensure that there is still a gap of 1 – 2 mm between the humeral head and resection level.

With the humeral stem template, stem size is determined preferably by using the medium body height template of 35 mm. The resection level already established is again used for orientation with regard to implant depth and hence stem size. The appropriate body should come to rest slightly distal to approximately 3 – 4 mm below the humeral resection.

The size of the inclination set depends on the required distance between the body and the humeral head and can be read off the heights marked on the radiographic template for the inclination set. The definitive sizes of body and inclination set are generally decided during the operation, when after implantation of the definitive stem the optimum anatomical reconstruction is established using trial components. The inclination, version, and eccentricity of the humeral components are adjusted during the operation.

Note
One must keep in mind that different combinations of body height and inclination set height will alter the eccentricity of the humeral head. During surgery, the correct position of the inclination set can be determined using the trial humeral head and marking the location of the inclination set trunnion on the osteotomy. Determining where the inclination set should be located, based on humeral head offset, will ensure proper anatomical placement of the humeral head.

Precise planning is particularly indicated for fractures because the ability to determine the sizes of prosthetic components is often limited. The appropriate X-ray images of the opposite side serve as a basis for prosthetic planning. After that, planning has to be correlated with the fracture situation. For precise assessment of complex humeral head fractures, a CT scan can provide additional information. It is crucial to determine the implantation depth of the humeral stem before the operation by utilizing the available planning in conjunction with fracture analysis. An average retroversion of 30 – 40° can be obtained intraoperatively by the position of the stem broaches, adjustment of the body, and/or adjustment of the inclination set. Keep in mind that the normal version of the humeral head may vary from 5° of anteversion to 60° of retroversion. Careful analysis of the opposite shoulder in the axillary lateral view can provide the most information regarding the patient’s particular anatomy. Next, the adjustment of inclination by the inclination set is
conducted according to planning and a neutral average of 132.5°. The true AP view of the opposite shoulder will provide a more specific determination of the patient’s neck-shaft angle. After prosthesis assembly, the fracture fragments of the metaphysial humeral head region (essentially the greater and lesser tuberosities) are fitted between the humeral stem and humeral head component and fixed with sutures. The PROMOS® body provides 4 lateral suture holes and 1 medial suture hole for fracture attachment.

For a more detailed explanation on using the PROMOS® Modular Shoulder System in proximal humerus fractures, please refer to the PROMOS® Fracture Surgical Technique.

5. Patient Positioning

The patient is placed in a semi-sitting (beach chair) position, inclined approximately 30° or more. The patient should be positioned on the operating table as far as possible to the side being operated on. The shoulder and arm should come to rest beyond the edge of the table in order that the arm can be freely extended, adducted slightly, and subjected to external rotation. Especially in the case of obese patients, it is important to ensure good positioning with appropriate freedom of arm movement. Adequate exposure of the dislocated proximal humerus without torsional or flexural forces being exerted on the humerus by the edge of the table is essential for neat, safe implantation of a shoulder prosthesis.

The sterile drape is placed so that the arm can be moved freely during the operation.
6. Surgical Technique

Approach to the Glenohumeral Joint
A standardized deltopectoral approach is recommended. An anterolateral McKenzie technique can be used as an alternative. Both approaches call for anatomically accurate and stable reinsertion of the muscle-tendon units (subscapularis tendon and/or the deltoid muscle). The deltopectoral interval is opened medial to the cephalic vein to preserve venous discharge from the deltoid muscle. The anterior humeral circumflex vessels are exposed and ligated. The anatomical landmarks (rotator interval, bicipital groove, lesser and greater tuberosities) allow precise orientation in relation to the humeral head. The subscapularis tendon is transected 1 cm medial of the insertion on the lesser tuberosity together with the articular capsule and reinserted later with a direct side-to-side suture of the tendon ends. Alternatively, the subscapularis tendon can also be detached from the lesser tuberosity with an osteotome and reattached with transosseous sutures, wires, or with a screw. Lengthening of the subscapularis is not needed if a complete release is performed. This step is crucial for adequate postoperative range-of-motion.
(see below)

We recommend circumferential mobilization of the subscapularis tendon. This is achieved by incision of the rotator interval including transection of the coracohumeral ligament at the base of the coracoid. Then the capsule is sharply released from the anterior glenoid and adhesions are resected, including the more medial tendon muscle unit from the anterior scapular neck. By means of this circumferential release, the tendon-muscle unit of the subscapularis muscle becomes functional again with normal excursion.

A continuation of the capsulotomy with release of the capsular contractures, especially inferiorly, facilitates the subsequently necessary dislocation of the humeral head in order to expose the humerus for humeral head preparation and anatomical resection. After humeral head resection, a capsulotomy is completed in a later step, the aim being circumferential arthrolysis.
Resection of the Humeral Head

Exposure of the humeral head is performed with cautious external rotation while the arm is held in the adducted and extended position. First, this maneuver is only possible if the patient is positioned correctly. The exposure is facilitated by the above-described release of capsular contractures by means of an extensive semi-circumferential capsulotomy. As a result, complete external rotation is made possible with corresponding humeral head exposure without any flexural or torsional forces acting on the humeral stem. The patient's hand should point toward the head of the bed.

Then the humeral osteophytes are completely removed in order to expose the anatomical neck of the humerus. The capsular reflection defines the anatomical neck ventrally, inferiorly and superiorly, and thus defines the resection level.

Note
Exact exposure of the anatomical neck, and hence the resection level, is a prerequisite for accurate resection of the humeral head and consequently anatomical shoulder reconstruction. Anatomical resection of the humeral head will retain the patient’s native humeral head inclination, version and size.

The resection level corresponds to the tendon insertions of the subscapularis and the supraspinatus. Viewed dorsally, the cartilage-free zone from 6–8 mm medially of the tendon insertion of the infraspinatus and the teres minor must be taken into account (ie. Preserve the bare area posteriorly). The humeral head is therefore resected along the level of the anatomical neck using an oscillating saw. The average angle of inclination is approx. 135° for the humerus. Because of the adjustability of the inclination part of the PROMOS® shoulder prosthesis, this angle can be infinitely adjusted by ±12°. Humeral version varies between 5° anteversion and 55° retroversion (20–40° retroversion on average).

In the case of secondary arthrosis, (e.g. after dislocated humeral head, multi-fragment fractures with often persistent malalignments of the tuberosity), resection of the humeral head is performed to allow substantial room for maneuvering. Taking the condition of the soft tissues into consideration, the prosthesis can thus be adapted to suit the changed insertion areas of the rotator cuff and also the incorrectly healed tuberosity. As a result, additional osteotomies of the tuberosity can be avoided.
The size of the prosthesis head can be determined by comparative superimposition of the trial head over the resected humeral head.

Preparation of the glenoid and implantation of the glenoid component

After humeral head resection, the arm is returned to the neutral position. In order to expose the glenoid, the humeral head is retracted posteroinferiorly using a humeral head retractor which is applied to the posterior glenoid neck, along the posterior osteophytes. In addition, sharp and blunt retractors are employed around the glenoid, usually with one anteriorly on the scapular neck and one inferiorly at the glenoid neck. The capsulotomy is completed dorsally in order that the result is circumferential arthrolysis with complete soft tissue release. This is the only way to completely expose the glenoid, which is a prerequisite for clean implantation of the glenoid component.

Next, the glenoid is debrided down to the osseous glenoid by removing any remaining parts of the anterior lip osteophytes and any residual cartilage.

The prerequisite for accurate anatomical implantation of the glenoid component is identification of the arthrosis-induced bony glenoid change in each specific case. Preoperative signs can be obtained from axial beam X-ray images and a CT scan or MRI if necessary. Glenoid retroversion may only be caused by excessive posterior articular cartilage wear and must be recognized in order to correct glenoid version, if needed.

Determining glenoid size

There are also radiographic templates available for determining the size of the glenoid component before the operation.

Here too, final determination of glenoid implant size is performed intraoperatively with the aid of a transparent glenoid template (sizes 1 – 4). The template is positioned using the holder in such a way that the surface of the glenoid fossa is completely covered by the relevant glenoid template. When trying to decide between two sizes, the smaller size should be selected.
Positioning the Kirschner wire

The 2 mm Kirschner guide wire is passed through the central hole in the correct glenoid template. There are 15° of freedom between the Kirschner wire and the guiding hole. Consequently, any off-centre glenoid wear can be corrected. The direction of the Kirschner wire should be perpendicular to the required corrected version of the glenoid implant. After placing the Kirschner wire, the glenoid template is removed and the correct position of the Kirschner wire is checked again.

Drilling the central anchorage hole in the glenoid

The central drillhole is made using the Kirschner guide wire and a cannulated 6.5 mm drill. The drill is driven forward up to the stop and then the Kirschner wire is removed.

Reaming the glenoid fossa

The peg of the glenoid reamer is inserted into the central drillhole. The sizes of the reamers correspond to the various glenoid sizes. Protecting the axillary nerve, the glenoid fossa is reamed gradually and taking the required correction in consideration, starting with the smallest size, until the size of the glenoid implant selected has been reached. For the size 1 glenoid either the smallest reamer (1) or the second reamer (1–2) can be used. In order to prevent glenoid fractures, the reamer should be started up before making contact with the bone. Care is taken to preserve glenoid orientation with each pass of the reamer.
The glenoid drill guide of the appropriate glenoid size is now mounted on the drill guide holder so that the handle is ventral and the wider part of the drill guide with the 2 holes is caudal (see illustration for a left shoulder).

The drill guide is now positioned on the prepared glenoid surface and secured in the central drilled anchorage hole with the 6.5 mm centering peg. Rotation of the drill guide around the centering peg makes it possible to align the glenoid drill guide on the longitudinal axis of the glenoid until the required position has been reached. The spikes on the backside of the drill guide shall be impacted into the glenoid fossa using a punch.

After drilling the peripheral glenoid anchorage holes with the 5.5 mm drill up to the stop, a 5.5 mm centering peg is introduced for stabilization of the glenoid drill guide after each drilling step. The 5.5 mm drill used for the peripheral anchorage holes can be used either rigidly or on the flexible drill shaft.

The drill guide is stabilized peripherally using at least 2 centering pegs. The center drillhole is drilled once again with the non-cannulated 6.5 mm drill.

**Note**

_Glenoid sizes 1 and 2 have an identical distance drill hole pattern. Glenoid sizes 3 and 4 also have an identical drill hole pattern, yet it is larger than sizes 1 and 2. Consequently, after drilling the peg holes of glenoid sizes 1 and 2 it is possible to switch between sizes 1 and 2. The same applies to sizes 3 and 4. It is not possible to switch between sizes 2 and 3._
Determining the glenoid radius

The radius of the selected humeral head component determines the radius of the glenoid component. The prerequisite for determining glenoid radius is therefore knowledge of humeral head radius. This is determined as a preliminary figure before the operation using radiographic templates. The precise size of the humeral head component, however, is only determined during the operation, as described.

There are three radii available for each of the four glenoid sizes. The correct glenoid radius depends on the radius of the selected humeral head. The various possible combinations of glenoid sizes and glenoid radii with the corresponding humeral head can be seen by referring to the table. If the humeral head size cannot be precisely determined yet, the glenoid with the larger radius should be selected.

Ideally, there should be a 3–5 mm mismatch between the humeral head radius and the glenoid radius. Having a smaller radius humeral head in relation to the glenoid radius enables translation of the gleno-humeral joint.

Use of the inserter for the centering peg:

To load the inserter with a peg tilt the inserter slightly (1) then push softly over the peg until it clicks in. (2) The inserter is then removed together with the peg from the instrument tray. (3)

Insert the peg into the predrilled hole of the guide and push the knob of the metal rod to release the peg. (4)

Note
The inserter centering peg has been constructed to require only manual manipulation. This instrument is not intended to either experience hammering blows or impulse forces from other instrumentation or medical devices.

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Check with the trial glenoid and implantation of the glenoid component

Before implantation of the definitive glenoid component, the transparent trial glenoid is inserted to check glenoid reaming, peg anchorage holes, and the size of the preselected glenoid implant. For placement and removal of the trial glenoid, the glenoid holder and the glenoid extractor are used.

Clear exposure of the glenoid with drying of the anchorage holes is the prerequisite for correct cementing. Only the glenoid pegs should be cemented, not the entire posterior surface of the glenoid. The introduction of cement into the 4 peg anchorage holes is performed preferable with a cement syringe. The definitive glenoid component is placed in the glenoid holding block. The glenoid holder is positioned in the cavities around the glenoid component and fixed in place. After introduction and impaction of the glenoid component using the glenoid holder and the glenoid impactor, any excess cement is removed, and pressure on the glenoid is maintained until the cement has hardened. When it has hardened, the position of the implant is checked.

Preparation of the humerus – opening the humeral canal

The proximal humerus is exposed again by cautious external rotation while the arm is kept in an adducted, extended position. The point of entry for the awl in order to open the medullary cavity is usually in the most superior part of the resection level, 6–8 mm posterior to the bicipital groove. The awl is introduced in an antegrade manner.
Preparation of the humerus

Starting with the smallest stem rasp, the humeral stem is broached using the rasp adaptor. Introduction of the stem rasp is ideally performed perpendicular to the diaphyseal humeral stem and at right angles to the resection level of the humeral head. One must bear in mind the osseous shape of the proximal humerus, especially in the case of secondary arthrosis with post-traumatic malalignment. The humeral version should have already been determined with the humeral osteotomy.

Note

One advantage of the PROMOS® system over conventional shoulder prosthetic systems with monoblock humeral stem components is the modularity in the stem region (diaphyseal stem, metaphyseal body). Because of this modularity, it is possible to mix and match different body sizes with different stem sizes in order to exactly match a patient’s anatomical requirements. In addition, the body can be rotated in relation to the stem. This variability makes it possible in the event of an incorrectly healed post-traumatic arthrosis or an errant humeral neck osteotomy, to adapt the implant in situ to the corresponding malalignment. In many cases, additional osteotomies can thus be avoided.

The humeral stem is broached step by step, whereby care must be taken to ensure that during impaction and removal of the rasp, no torsional or flexural forces (e.g. due to lever out over the edge of the operating table if positioning is inadequate) come to act on the humeral stem. In particular, torsional forces due to holding of the arm must be avoided to minimize the risk of a humeral stem fracture in patient’s with poor bone quality. The stem rasps should be introduced into the humerus as far as possible until one of the three marks on the rasp coincides with the resection level. The center mark corresponds to the 35 mm body mounted on the stem.

The humeral canal is prepared with the stem rasps until there is intimate contact between the rasp and the cortical bone while impacting. Ideally, the size of the rasp should correspond to the size which was determined in preoperative planning. Introduction of the rasp to the upper or lower line can be compensated by using the smaller or larger body.
A half size stem has to be considered if an intimate contact can not be reached and the next full size would be too large. In this case rasping over the 3rd mark with the smaller rasp is indicated. The next half size stem will sit as high as the 1st mark prepared for the smallest body. However, the next bigger size rasp can be used carefully in order to reach the cortical bone with finishing off with the smaller rasp to check depth and to remove enough bone for the body.

For very small patients a mono block stem is available where the body is incorporated into the stem. The stem offers a choice of 3 heights in 5 mm steps.

**Note**

*One must remember that a change in body height (in combination with the height of the inclination set) exerts an influence on the offset of the humeral head implant.*

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**Trial stem and body in the humerus**

To check humeral stem preparation, the inserter is connected to the T-handle and the holding screw for implanting the trial stem and introduced into the medullary space.

**Note**

*This step is important to ensure a proper diaphyseal fixation of the distal stem. If the stem and inserter pass the 3rd mark of the inserter, the next size stem has to be considered.*

The corresponding trial body is now screwed onto the trial stem in situ. The trial body should be positioned slightly distal to approximately 3–4 mm below the humeral resection. When the correct sizes of trial components (stem and body) have been found, they are removed.

**Stem implantation**

Preparation of the definitive stem to be implanted is performed by attaching the appropriate size of humeral stem component to the inserter.
The stem is impacted carefully until the implantation height determined with the trial components, which is often on the center line, has been reached. The axial orientation determined in advance must be observed. Then the inserter is carefully removed from the stem by loosening the holding screw.

The modularity of the PROMOS® system on the humeral implant permits assembly and disassembly of the various components in situ. Even after implantation of the definitive stem, the trial body can be attached to the definitive implant stem. From here, a trial inclination set and trial humeral head can be attached to check the anatomical adaptability of the chosen components.

**Trial body**

The required trial body is placed on the cone of the inserted definitive stem and fixed to the stem with the screw in the body. The correct height of the body selected is checked again.

The diagonal top edge/plane of the body selected does not have to be parallel to the angle of the resection plane. The difference between these two planes is due to the anatomical resection of the humeral head. The head was resected at an anatomical inclination and version and not according to a fixed angle. The aim is, with an appropriate selection of inclination set and eccentric humeral head, to optimally adapt the prosthesis to the osseous shape or bony anatomy of the humerus.

**Trial inclination set**

Further assembly of the prosthesis is conducted using the trial inclination set. The tapered trunnion of the inclination set should ideally be positioned in the lower third of the resection level and should line up with the location on the resection that allows optimal placement of the offset humeral head to ensure coverage of the osteotomy.
For optimum positioning of the inclination set with regard to inclination and version, the inclination set adjuster and holding fork are mounted on the tapered trunnion. Care must be taken to ensure smooth movement of the saddle joint. The trial inclination set is fixed to the body in the optimum position by tightening the center screw.

The circumferential clearance of 1–2 mm between the inclination set adjuster and the resection surface is verified with the resection caliper.

Contact must be prevented between the humeral head and the resection level to ensure complete connection between the humeral head and the inclination set trunnion.

**Trial head**

The trial head is mounted on the trial inclination set and rotated until optimum coverage of the resection level is achieved. The head should never be too large.

The humeral heads offer the choice of two different eccentricities. The transparent trial heads correspond to the implant heads with a growing eccentricity from +2mm to +7mm. The blue trial heads are corresponding to the fixed eccentricity of +4mm for all sizes.

**Note**

*If the eccentric position of the head does not permit adequate coverage of the osteotomy, it can be corrected with a different combination of body and inclination set.*
**Trial reduction and verification of stability/function**

The joint is reduced with the stable trial prosthesis in order to check shoulder function and articular stability. Relaxed, the glenohumeral joint should be well centered. When checking, it should be possible to subluxate the humeral head in relation to the glenoid by approximately half a head’s width posteriorly. Relaxed, the humeral head component should be well centered in the glenoid with arm in neutral rotation.

The shoulder joint is dislocated carefully with humeral external rotation, the trial components are removed for implantation of the definitive prosthesis components.

Prior to implantation of the definitive body, transosseous, non-absorbable sutures (No. 5 or larger) are placed through the lesser tuberosity. This facilitates subsequent refixation of the subscapularis tendon. If adequate soft tissue was left attached to the lesser tuberosity, direct tendon-tendon repair can be done without transosseous sutures.

**Implantation of the body**

The cone of the stem already implanted is cleaned and dried. Then the body selected is mounted on the cone in the correct position and pressed tight.
The body is pressed onto the distal stem with the aid of the clamp for in situ assembly (1). For in situ assembly, the two-part connection screw (2) is introduced into the assembly clamp, and the adaptor (3) corresponding to the body height is mounted on the assembly clamp. The assembly clamp is placed on the body and the connection screw is tightened to the distal stem with the clamp handles wide open. When the clamp handles are squeezed together the body is fixed to the stem without driving the stem deeper. Then the connection screw is tightened again and the clamp handles are pressed together. This process should be performed a total of three times. The force applied is sufficient to achieve a stable joint between the body and the stem. The clamp is now released and removed.

The connection between the body and the stem is also secured with the screw included. The screw is tightened using the torque screwdriver.

Torque the torque screwdriver to the "Implant" mark. This step is essential to secure the implant inclination set.

Before choosing the definitive inclination set, the trial inclination set can be inserted again and the correct position of the humeral head can be set and checked again.

Note
Verify that when no torque is applied to the torque screwdriver, the torque indicator rests at the "Neutral" mark.

The torque screwdriver is a measuring device. Do not apply impacting forces with a mallet or similar instruments in any situation as this will cause damage to the instrument.
Mounting the inclination set on the body

The definitive inclination set is now screwed onto the body. Care must be taken to ensure that the connecting surfaces are clean. Correct inclination and version are adjusted with the aid of the inclination set adjuster and the holding fork to ensure smooth movement, as already described. With the resection caliper, one should again verify the clearance of 1–2 mm between the resection level and the inclination set adjuster. If necessary, a trial reduction can be repeated with the trial head.

While the holding fork stabilizes the tapered neck, torque the center screw to the “Implant” mark using the torque screwdriver.

Implantation of the humeral head component

The definitive humeral head is lightly placed on the clean, dry cone of the inclination set and rotated in place until it optimally covers the resected surface. Once the definitive head is in the correct position, impact the humeral head on the inclination set with three hammer blows using the head impactor. The joint is reduced and another check on shoulder function and joint stability is performed.

Note
After impaction of the head to the trunnion of the inclination set, the connection can be checked by hand.
Detachment of the body from the distal stem

Because of the modular design of the PROMOS® shoulder, it is possible to detach the body from the distal stem again and, if necessary, modify the configuration of the proximal humeral components. To detach the body from the distal stem in situ, a releasing clamp is available. The screw for connecting the body to the distal stem must be removed before using the releasing clamp.

The prepared, mounted releasing clamp is attached to the body when the sleeve (F) has been undone with a 90° turn (assisted by applying slight pressure to the sleeve). The sleeve is then re-attached and the rotary head is rotated into the implant up to the stop with the threaded rod. By squeezing the two levers together, the body can now be easily detached from the stem.

Sequence of assembly/dismantling for cleaning

Sequence of assembly:
1. Spring (A)
2. Base disk (B)
3. Locking screw (C)
4. Screw head (D) onto threaded rod (E)
5. Insert head/threaded rod into sleeve (F)
6. Attach sleeve (F) to the top lever (G) with a one-quarter turn (90°)

Note
When the releasing clamp is assembled, the top lever (G) never makes contact with the bottom lever (H) but is always pressed upwards by the force of the spring.
**Wound closure and postoperative immobilization**

The prepared, non-absorbable transosseous sutures are used for the reinsertion of the subscapularis tendon or with side-to-side repair of the tendon stumps. Then the rotator interval can be closed. Be sure the interval is closed with the arm in external rotation in the adducted position to prevent a loss of rotation. An optional drain can be placed, but it is usually not needed if adequate hemostasis and good soft tissue technique was used throughout the procedure. The wound is then closed, layer by layer, using subcutaneous suture and skin suture. The sterile dressing is applied and the arm operated on is immobilized in a sling.
7. Recommendations for Rehabilitation

Phase 1

**Assistive mobilization – first and second week after surgery**

Therapy

- Assisted movement in the scapular region

**Note**

*External rotation with passive assistance up to 40° maximum (depending on intraoperative motion)*

- Various soft tissue techniques
- Scapular setting, postural correction
- Start of centering exercises in the dorsal position, taking the scapular region into account
- Oscillatory exercise instruction
- Water therapy as of Day 5
- Sling is used for protection only, not immobilization

Phase 2

**Active mobilization and coordination training – third and fourth week after surgery**

Therapy

- Exercises in various starting positions
- Isometrics of the rotator cuff with short lever and adapted resistance, techniques as in the PNF patterns (proprioceptive neuromuscular facilitation), etc.
- Stabilization and centering exercises to improve sensor motor function
Phase 3

Activation and ergonomics – as of the 5th week

Therapy

- Increase in active and passive mobility
- Intensification of glenohumeral and scapulothoracic coordination training, including the trunk
- Improvement in stamina – combined with medical training therapy if possible
- ADL (Activity of Daily Living) training

Objectives for 6 weeks after surgery

- Passive glenohumeral function of at least 100°
- Touching the crown of the head
- Hand behind back at least to the trochanter

Objectives for 12 weeks after surgery

- Free movements (depending on preoperative condition and progress)
- Hand behind back and grip to nape of neck

8. Sterilization

Implants
All the implants described in this surgical technique are supplied by the manufacturer in a sterile condition. Resterilization is not allowed.

Instruments
The system instruments are non-sterile when delivered. Before use, they must be cleaned by the usual methods in accordance with hospital regulations and sterilized in an autoclave in accordance with the national legal regulations and recommendations. (For detailed information please refer to the leaflet Lit. No. 1363.)

For correct settings, refer to the user instructions issued by the autoclave manufacturer. Instrument manufacturers and dealers do not accept any responsibility for the sterilization of products by the customer.
## 9. Implants

**Glenoid, cemented**

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**Monoblock Stem, non-cemented**

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PROMOS® is a trademark of Plus Orthopedics AG, Switzerland, registered in Switzerland and other selected countries.

EasyTray™ is a trademark of Plus Orthopedics AG, Switzerland.
Please note that all humeral stems are compatible with all bodies; all bodies are compatible with all inclination sets; and, all inclination sets are compatible with all ball heads. The glenoid component is, however, specific to ball head size.

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