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**Indications**
A total prosthesis for the wrist is indicated in case of painful, functionally impairing joint damage as a result of rheumatoid arthritis or degenerative arthrosis.

**Contraindications**
- Lack of motivation on the part of the patient
- Heavy manual work
- Unfavorable local preconditions such as tendon insufficiency or insufficient bone stock

**Note:**
But joint replacement only makes sense when surgery for preserving mobility (e.g. partial carpal arthrodesis) is no longer possible and radiocarpal arthrodesis has to be taken into consideration. Reverting to arthrodesis is always a possibility. A total prosthesis, therefore, means gaining precious time above all for patients with rheumatoid arthritis.
The aim of developing a total wrist prosthesis was to achieve wrist function as near normal as possible and reconstruction of the carpus. Since the very complex kinematics of the wrist are not at all easy to copy, a compromise had to be found. The fact that, generally speaking, the center of motion of the wrist is situated consistently in the head of the capitate bone was a crucial factor in the decision to use a ball-and-socket joint, this being the simplest form of joint.

In addition, a ball-and-socket joint enables free mobility in all directions, as well as some distraction.

The MWP III total wrist prosthesis, designed for uncemented anchoring, is a direct further development of the cemented wrist prosthesis implanted for the first time in 1971 and that has been constantly improved on since then.

It is designed as a ball-and-socket joint and consists of a proximal ball component and a distal socket component. The tried and tested Durasul® Highly Crosslinked Polyethylene CoCrMo pairing is used for articulation. The instrument set with positioning guides has been revised.
Immediate mechanical stability (primary fixation) is achieved both by means of the anchoring stems fitting proximally into the radius and distally into the carpus and into the metacarpal bones and thanks to the function of the anchoring fin. Secondary anchoring is enabled by biological integration of the prosthesis surface into the adjoining bone structure (osseointegration).

The wrist prosthesis is made of the high-performance forged Protasul®-100 Ti-6Al-7Nb alloy, and has a matte, rough-blasted surface.

The ball head is made of the Protasul-20 Co-28Cr-6Mo alloy. The radial component and the ball are coupled by means of a tapered plug-and-socket connection.

The cup inlay, made of Durasul highly cross-linked UHMW polyethylene, is screwed into the shell intraoperatively.

Thanks to the modular nature of the ball head, alongside the matched use of:
- small radial component – small carpal component or
- large radial component – large carpal component.

the following combination is also possible:
- large radial component – small carpal component

It is also possible, theoretically, to combine a small radial component with a large carpal component, although from the clinical point of view this will be found only rarely.
Description of the Implants

The Carpal Component
The carpal component is available in separate left-hand and right-hand versions. It consists of a socket-shaped part plus the anchoring stems, which are tilted in a dorsal direction in respect of the joint socket and offset in a radial direction. Both anchoring stems, which have an elliptical cross-section, are straight and are thickened on the proximal side. The ulnar stem runs parallel to the radial stem and leads into the socket part at an angle. If required, the anchoring stems may be bent slightly with the bending iron to adapt them to the axes of meta-carpals II and III. The outer shape of the socket is that of a truncated cylinder with a rounded upper edge. The socket is threaded internally for connecting the Durasul polyethylene inlay into place. A stabilizing fin with holes leads over the top of the socket part onto the medial anchoring stem and in the proximal part, between the anchoring stems, there is a built-in reinforcement rib with drilled holes. Both the rib and the stabilizing fin also have the purpose of increasing the surface area, so as to promote the on-growth and in-growth of newly formed bone.

The Inlay
The inlay is made of Durasul polyethylene. It has three grooves, into which the setting instrument engages.
The Ball Head
The ball heads, available in two sizes, S (10 mm) and L (12 mm), have an inner cone that fits onto the cone of the radial component.

The surface is polished to a mirror finish. The size of the ball head matches the inlay of the carpal component.

The Radial Component
The same radial component can be used both for the left hand and the right hand. It consists of the U-shaped anchoring stems and a built-in ball part. The ball is offset towards the ulna, and the base of the ball corresponds to the joint between the radius and the lunate bone.

The anchoring stems, the cross-section of which is elliptical, are arranged distally parallel to one another and if required they can be bent slightly (widening them out if the medullary cavity is wide, in order to prevent subsidence).

The distal region of the radial component is reinforced by a built-in rib with holes in it as well as by a lateral stabilizing fin. Both the reinforcement rib and the stabilizing fin also have the function of increasing the surface area, so as to promote the on-growth of newly formed bone.
Preoperative Planning

Carry out preoperating planning with the help of templates, thanks to which the size of the prosthesis can be established, both for the left hand and for the right hand.

Templates on a 1:1 scale are available for all 4 pairing options:
Surgical Technique

Positioning the Patient
The patient is placed on his back with his arm positioned on a hand support. Brachial plexus anesthesia. Pneumatic upper-arm tourniquet (Fig. 1).

Approach
Dorsal longitudinal incision, running on a slight slant in a distal/radial to proximal/ulnar direction (Fig. 2).

Prepare the extensor retinaculum carefully, detaching it and folding it away in a radial direction. The extensor retinaculum should be retained for subsequent reconstruction (Fig. 3).

Expose the extensor tendons and make a cross-wise incision in the radiocarpal joint. Create a distally attached joint capsule flap (Fig. 4).
**Bone Resection**

Resect the distal radial joint surface sparingly. In the region of the carpus resect: the lunate bone, the proximal part of the scaphoid bone and possibly also the triquetral bone (Fig. 5).

As much as possible of the bone of the carpus, above all on the palmar side, must be retained.

**Preparing the Prosthesis Scar**

Drill the first anchoring hole for the prosthesis in the capitate bone. Screw the awl cautiously and slowly into metacarpal III with the help of the positioning guide.

The cortical bone should not be perforated while doing this. Introduce the awl exactly parallel to the dorsal cortical bone of metacarpal bone III and as far dorsally as possible.

Putting the carpal clip (positioning guide) into place will make this step easier. Use the feeler gauge or a small bone curette to check that the drilled hole is correctly situated in the bone (Fig. 6 and 7).

Determine the exact position of the second anchoring hole in metacarpal II with the help of the trial fork. Prepare this anchoring hole in the same way as the one in metacarpal bone III. Make a notch between the two anchoring holes with the bone rongeur to accommodate the built-in reinforcement rib. Check the direction, depth and diameter of the anchoring holes with the trial fork.

The correct position of the prosthesis can be seen in the figure 8. The joint socket must be firmly anchored in the bone, and palmar support is essential for this.

An X-ray check is recommended.
Preparing the Socket Seat

With the help of the trial fork already introduced, set the direction of the reaming axis with a Kirschner wire. To do this, place the Kirschner wire on the trial fork in one of the grooves. The direction of the wire will point precisely in the direction of the middle of the socket (Fig. 9).

Prepare the seat for the socket with the reamer (Fig. 10). This will be guided by a Kirschner wire, introduced at an angle of 15° from the longitudinal axis of metacarpal III, leading out from anchoring hole III. A palmar bony shell must definitely be retained.

Introduce the carpal component on a trial basis, but without driving it forwards into its final position (Fig. 11, part a). Then remove the carpal component with an impactor/extractor instrument.

Preparing the Radius

Prepare the two anchoring holes on a neutral plane in the center of the radius with the awl without removing the cancellous bone. Introduce the radial component until the built-in reinforcement rib starts to penetrate into the cancellous bone. Remove the prosthesis again after making sure of the correct position (Fig. 11, part b).
Introducing the Prosthesis

Clean the articular space, removing any bone fragments, and irrigate it.

Introduce the prosthesis components, first the carpal component and then the radial component, and drive them forwards into their final positions with their respective impactors (Fig. 12). It is frequently necessary to add cancellous bone tissue distally in the region of the carpus and of the metacarpal bones as well as proximally in the radius.

After removing the setting instrument, screw the Durasul PE inlay into place. To do this, fit it onto the appropriate setting instrument. It is advisable to turn the inlay first in an anticlockwise direction until the starts of the threads coincide, which can be noticed thanks to a slight click. Then screw in the inlay and tighten it moderately (Fig. 12).

Now introduce the radial component (Fig. 13). The last step is to fit the matching ball head onto the cone of the radial component and fix it in place with the head impactor (Fig. 14). First make sure that the cone is clean.

Reduce the joint and carry out a functional check. The positions of both prosthetic components must be checked radiologically during surgery, since the correct axial positioning of the prosthesis is of crucial importance.
**Possibility of Correction**
Should the distal radioulnar joint no longer be congruent (excessive resection of the radius or unstable ulna or ulnocarpal impaction), resect the ulnar head sparingly at a slant. If the tendon is too tight, remove the radial component and carry out an additional resection of the radius. Leave the carpal component in place (Fig. 15).

**Bending of the Anchoring Limbs**
The two anchoring stems can be bent by a maximum of ±5° with the two bending irons, in order to achieve better adaptation to the two metacarpal bones (Fig. 16). Excessive bending may lead to breakage of the anchoring stems.

**Reuse of the Taper and/or Thread Connection**
If you have established without doubt, that the removed Radial Head and the taper plug connection and/or that the removed Carpal Inlay and both threads (the thread of the Carpal Component and the tread of the Carpal Inlay) are still in perfect conditions, you may place the same component backwards. Otherwise, use a new component or new components.

**Closing the Wound**
Cover the prosthesis with the joint capsule flap (Fig. 17). If the flap cannot be stitched proximally to the radius without causing tension, displace the proximal part of the dorsal carpal ligament under the extensor tendons and stitch it to the joint capsule. Reconstruct the distal half of the extensor retinaculum over the extensor tendons in such a way that the ECU-Tendon is retained dorsally. Occasionally, a special retaining loop has to be made for this purpose. Before closing the wound, remove the tourniquet and carry out careful hemostasis. Position a suction drain in the articular space. Close the wound in layers and apply a padded dressing with a plaster palmar splint.
**Postoperative Treatment**

It is the responsibility of the doctor to decide which postoperative treatment is appropriate depending on each patient’s health condition. A dynamic splint may be necessary if there is a tendency towards malpositioning. In the first place, reliable stability must always be achieved. Mobility will depend on the patient’s needs. It should never be forced at the expense of stability or in order to reach extreme positions.

**Case Study**

66-year-old patient, rheumatoid arthrosis

![Preoperative](image1)

![10 years postoperative](image2)
Implants

MWP III Radial Component

Protasul®-100 Alloy
ISO 5832-11

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MWP III Carpal Component

Protasul®-100 Alloy
ISO 5832-11

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MWP III Ball Head

Protasul®-20
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MWP III Durasul® Inlay

Durasul® PE
ISO 5834-1/ISO 5834-2

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## Instruments

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All instruments are part of the MWP III Uncemented Total Wrist Prosthesis – Surgical Technique.
References


Also available in Zimmer’s Hand Portfolio:

Elogenics® Finger Prosthesis

Contact your Zimmer representative or visit us at www.zimmer.com

Lit. No. 06.01230.012 – Ed. 08/2010 ZHUB