



# Wagner Cone Prosthesis™ Hip Stem

Surgical Technique



Designed for Difficult Bone Conditions



## **Surgical Technique Wagner Cone Prosthesis Hip Stem**

Developed in conjunction with

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## Historical Timeline

- The original *Wagner Cone Prosthesis*™ Stem with a 135° neck angle was designed by Prof. H. Wagner of Germany
  - First implantation occurred in 1990
  - Full market introduction occurred in 1992
- Design was updated in 2006
  - No design changes were made in the zone of primary fixation
  - Enlarged proximal shoulder with ribs through the tip of the shoulder for an increased osseointegration surface
  - Slimmed neck and shortened head/neck taper for an increased range of motion
  - Added a 125° neck angle version to address varus anatomy



1990–2006



From 2006 *Wagner Cone Prosthesis* 125° and 135°

## Design Rationale

The *Wagner Cone Prosthesis Stem* is a *Protasul*<sup>®</sup>-64 titanium alloy stem that was designed for uncemented fixation in challenging bone conditions at the proximal femur such as proximal femoral deformities. The surface of the prosthesis is corundum blasted which, together with the characteristic shape, promotes bony apposition over a large area.<sup>1</sup>

A 5° tapered stem with a circular cross-section, the *Wagner Cone Prosthesis Stem* can be placed in any anteversion orientation by the surgeon. The stem has 8 longitudinal ribs with relatively sharp ridges intended for engaging the femoral cortex, allowing for optimum rotational stability.<sup>2</sup> The combination of longitudinal ribs and tapered geometry provides secure fixation. Therefore, the incidence of thigh pain associated with some uncemented prosthetic systems is minimally with the *Wagner Cone Prosthesis Stem*.<sup>3</sup>

In addition to providing rotational stability, the sharp longitudinal ribs of the stem are also beneficial for bony apposition. Clinical studies have shown very clearly that bone forms and attaches preferentially on the sharp-edged prominences of the implant<sup>1</sup>.

In order to achieve additional support of the prosthesis in the region of the calcar, the medial rib is extended distally through this area into the convex support surface. The ribs on the lateral side of the stem begin at the tip of the shoulder in order to ensure the greatest possible contact area in the trochanter region. Combined, this rib configuration provides rotational stability and improves osseointegration.



The circular cross-section facilitates unimpeded rotation during implantation for unlimited anteversion adjustment.

<sup>1</sup> Schenk R.K., Wehrli U. Zur Reaktion des Knochens auf eine zementfreie SL-Femur-Revisionsprothese. *Orthopade*. 1989; 18: 454–462.

<sup>2</sup> Bühler D., Berlemann U, Lippuner K, Jaeger P, Nolte L. Three-dimensional primary stability of cementless femoral stems. *Clinical Biomechanics*. 1997; 12: 75–85.

<sup>3</sup> Wagner H., Wagner M. Cone Prosthesis for the hip joint. *Arch Orthop Trauma Surg*. 2000; 120: 88–95.

## Implant and Instrument Descriptions

The *Wagner Cone Prosthesis Stem* is available in either of two different neck angles, 125° and 135°. This provides options to facilitate an appropriate restoration of biomechanical parameters including the center of rotation, offset, and leg length. Stems are available in 12 diameters from 13 to 24mm to fit the individual size of the intramedullary canal.

Included in the instrument set are a number of user-friendly instruments for implanting the *Wagner Cone Prosthesis Stem*. The key instruments are tapered reamers which are used for the careful preparation of the medullary canal. The use of tapered reamers is vital for preparing the canal in a bone conserving manner. This is especially important in the case of poor bone quality where the use of rasps may not be a viable option.

Modular trial components are included in the set to help determine appropriate implant sizing and the correct orientation of the femoral neck (anteversion). The trial stems of the *Wagner Cone Prosthesis Stem* are modular with a single distal component for each diametrical size and two proximal components representing the 125° and 135° neck angles. This allows intra-operative flexibility during trial reductions. The proximal components can be exchanged in situ while leaving the distal part in the canal to avoid damage to the bone. Please note that the distal components of the trial stems have only four ribs (instead of eight, as on the implants) to facilitate the extraction of the trial stem and to avoid unnecessary damage to the bone during the trialing procedure.



Reamer

Trial Stem

## Preoperative Planning

Effective preoperative planning allows the surgeon to predict the impact of different interventions in order to perform the joint restoration in the safest and most accurate manner. Optimal femoral stem fit, the level of the femoral neck cut, the prosthetic neck length, and the femoral component offset can be evaluated through preoperative radiographic analysis. Preoperative planning also allows the surgeon to have the appropriate implants available at the time of surgery.

The overall objective of preoperative planning is to determine the anatomic parameters that will allow accurate intra-operative placement of the femoral implant and optimal joint stability.

The specific objectives include:

1. determination of leg length
2. determination of the anticipated component size
3. establishment of appropriate abductor muscle tension and femoral offset

### Determination of Leg Length

Determining the preoperative leg length is essential for restoration of the appropriate leg length during surgery. If leg lengths are equal in both the recumbent and standing positions, the leg length determination is simplified; however, for most patients, leg lengths are not equal. The surgeon should determine the best treatment for various leg length discrepancies and note how this will impact the process of implanting the *Wagner Cone Prosthesis Stem*.

### Determination of Component Size

It is recommended that three radiographic views be evaluated when templating. Preoperative planning for insertion of a cementless femoral component requires an anteroposterior (A/P) view of the pelvis, an anteroposterior (A/P) view and a frog leg lateral view of the involved femur on 11x17-inch cassettes. Both views should show at least eight inches of the proximal femur. It may also be helpful to obtain an A/P view with the involved femur internally rotated. This compensates for naturally occurring femoral anteversion and provides a more accurate representation of the true mediolateral dimension of the metaphysis.

When templating, magnification of the femur will vary depending on the distance from the x-ray source to the film and the distance from the patient to the film. The *Wagner Cone Prosthesis Stem* templates (125° Neck Angle: 97-0561-050-00, 135° Neck Angle: 97-0561-051-00) use standard 20% magnification which is near the average magnification on most clinical x-rays. Large patients and/or obese patients may have magnification greater than 20% because their osseous structures are farther away from the surface of the film. Similarly, smaller patients may have magnification less than 20%. To better determine the magnification of any x-ray film, use a standardized marker at the level of the femur.

Preoperative planning is also important in choosing the optimal acetabular component and in providing an estimation of the range of acetabular components that might ultimately be required.

Begin the initial templating with the A/P radiograph. Superimpose the acetabular templates sequentially on the pelvic radiograph with the acetabular component in approximately 40° of abduction with the component medialized against the medial wall of the acetabulum. Range of motion and hip stability are optimized when the socket is placed in approximately 35° to 45° of abduction. Assess several sizes to estimate which acetabular component will provide the best fit for maximum coverage. Comparison of the contralateral, uninvolved hip is useful, particularly if any acetabular deficiency or abnormality is present. In most cases, select the largest component possible while being certain that the outside diameter isn't too large to seat completely in the acetabulum. Use of a lateral radiograph of the hip may be helpful for further determining the acetabular component size. (Refer to the *Trabecular Metal™* Acetabular System surgical techniques for further details on acetabular reconstruction. *Trabecular Metal* Modular Cup 97-7255-029-00 and/or *Trabecular Metal* Revision Shell 97-7255-008-00)

Consider the position and thickness of the acetabular component in estimating the optimum femoral neck length to be used. To simplify this, the acetabular templates are on a separate acetate sheet from the femoral templates. Mark the acetabular size, its position, and the center of rotation on the x-ray films. This allows any femoral component to be matched with the desired acetabular component by placing the femoral template over the acetabular template. This will provide the best estimation of femoral component size and head/neck length necessary to achieve the correct leg length.

The *Wagner Cone Prosthesis* Stem can be used with several head diameters. Select the femoral head size based on the surgical preference. Please consult your local Zimmer sales associate for more information regarding Zimmer femoral head options.

The specific objectives in templating the femoral component include:

1. determination of the anticipated size of the implant to be inserted
2. determination of the height of the implant in the femur
3. location of the femoral neck osteotomy.

When selecting the size of the *Wagner Cone Prosthesis* Stem it is important that the configuration of the femur allows for close contact between the middle third of the prosthetic stem and the femoral cortex and not just at the tip of the stem in the medullary cavity.

Selection of the correct stem diameter is particularly important. The most common mistake is choosing a stem diameter that is too small. Such a decision can result in secondary subsidence of the prosthesis. The outline on the template corresponds exactly to the dimensions of the implant.



Preoperative planning with digital templating



Postoperative

In choosing the diameter, it must be remembered that reaming removes a thin layer of bone and that the sharp longitudinal ribs cut slightly into the bone during insertion. The outline of the prosthetic stem on the planning template must therefore overlap the inner outline of the cortex in the region of the middle third of the stem by 1 mm on each side.

Lastly, the templates can be used to determine the appropriate neck angle ( $125^\circ$  or  $135^\circ$ ) to most optimally fit the patient's needs.

### **Determination of Abductor Muscle Tension and Femoral Offset**

After determining the requirements for establishing the desired postoperative leg length, consider the abductor muscle tension. When the patient has a very large offset between the center of rotation of the femoral head and the line that bisects the medullary canal, the insertion of a femoral component with a lesser offset will, in effect, medialize the femoral shaft. To the extent that this occurs, laxity in the abductors will result.

Although rare, it may not be possible to restore offset in patients with an unusually large preoperative offset or with a severe varus deformity. In such cases, the surgeon should use the clinically appropriate surgical approach to eliminate the laxity in the abductor muscles. Technical variations in the placement of the acetabular components can also reduce the differences in offset.

## Surgical Technique

### Exposure

The *Wagner Cone Prosthesis Hip Stem* can be implanted using a variety of surgical approaches. The specific approach used depends on surgeon preference. Also, the system is compatible with the *Zimmer® Minimally Invasive Solutions™* (MIS) techniques taught through The Zimmer Institute. Please contact your Zimmer Sales Associate for information on these surgical techniques.

For the purpose of illustration, the patient is shown having been placed in the lateral position with the intent of performing a posterior approach (Fig. 1).

### Determination of Leg Length

Establish landmarks and obtain measurements before dislocating the hip so that, after reconstruction, a comparison of leg length and femoral shaft offset can be obtained. From this comparison, adjustments can be made to achieve the goals established during preoperative planning. There are several methods to measure leg length. Select the most appropriate based on the surgical technique.

### Osteotomy of the Femoral Neck

Dislocate the hip based on the surgical approach as shown in (Fig. 2). Refer to the distance from the anatomic landmark(s) to the osteotomy level that was determined during preoperative templating to make sure osteotomy line is accurate. The resection line is then marked with a pen in a line across the femoral neck. Using the marked line as a guide, perform the osteotomy of the femoral neck. To prevent possible damage to the greater trochanter, stop the cut as the saw approaches the greater trochanter. Remove the saw and either bring it in from the superior portion of the femoral neck to complete the osteotomy cut or use an osteotome to finish the cut.

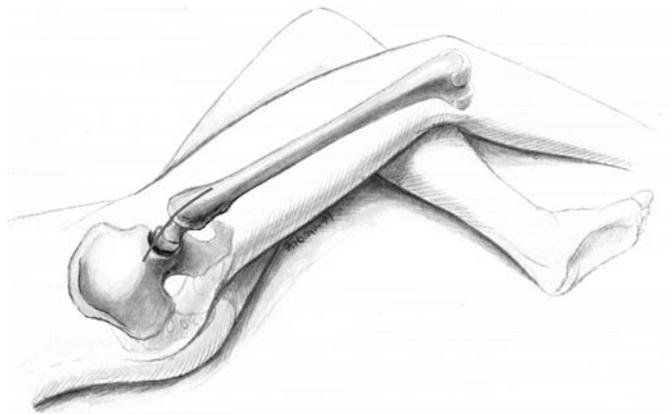


Fig. 1

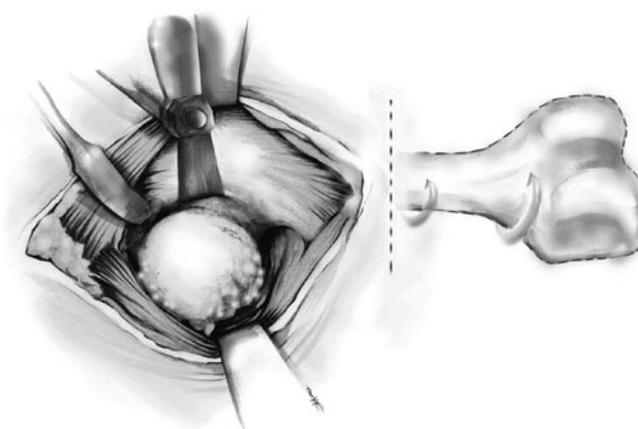


Fig. 2

### Preparation of the Femoral Canal

With the proximal femur extending from the wound, remove soft tissue from the medial portion of the greater trochanter and lateral portion of the femoral neck. It is crucial to adequately visualize this area so the correct insertion site for femoral reaming can be located (Fig. 3). Refer to the preoperative planning and identify the extension of the mid-femoral shaft intraoperatively as viewed on the A/P and lateral radiographs. This is usually in the area of the piriformis tendon insertion in the junction between the medial portion of the greater trochanter and lateral femoral neck.

Use a box osteotome, trochanteric reamer, or a burr to remove bone from the medial portion of the greater trochanter and the lateral portion of the femoral neck (Fig. 4). There must be sufficient space in this area for the passage of each sequential reamer to ensure neutral reamer alignment. Insufficient space may result in improper stem positioning. However, the space should not be larger than the rasp or implant.

The femoral medullary canal is progressively reamed with the Reamers in the longitudinal direction of the femur until noticeable resistance is felt (Fig. 5). The depth of penetration of the reamer can be checked with a K-wire placed on the tip of the greater trochanter.

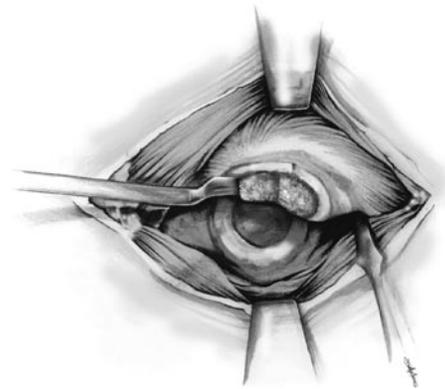


Fig. 3

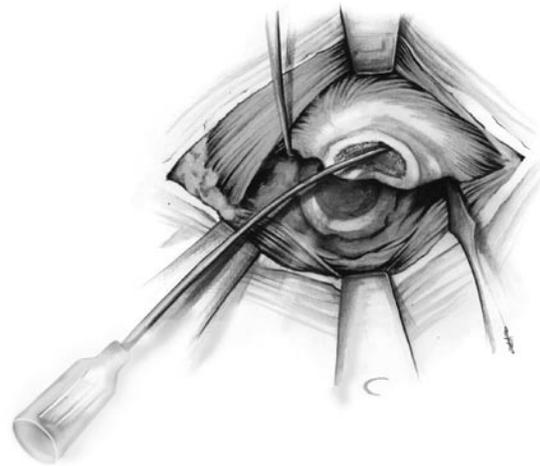


Fig. 4

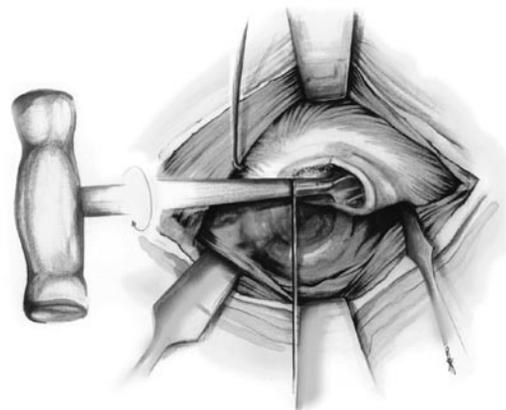


Fig. 5

### Trial Reduction

The diameter of the Trial Stem Distal Part should correspond to the size of the last Reamer used. The Trial Stem Proximal is selected according to the appropriate neck angle as defined in the preoperative plan. The diametrical size of the Trial Stem Proximal Part is chosen to correspond to the indicated distal component size.

It is recommended to assemble the trial stem outside of the body and to insert it as a single component. Mount the selected Trial Stem Proximal Part and Trial Stem Distal Part together and lock by assembling and tightening the Trial Stem Screw with the Screwdriver (Fig. 6a & 6b). Insert the trial stem assembly into the femur until it is properly seated (Fig. 7).

When there is severe pre-existing anteversion, ensure that the prosthesis is placed so that the neck of the prosthesis is not impinging on the cortex of the femoral neck. If necessary, some bone can be removed with a fine chisel until there is a sufficient gap between the neck of the prosthesis and the proximal bone.

Select the appropriate femoral head provisional as previously templated and seat it on the trial taper. Reduce the hip and verify leg length, femoral offset and range of motion. Trial with different femoral head provisional combinations as required to obtain satisfactory joint stability.



Fig. 6a



Fig. 6b



Fig. 7

If the trial reduction does not yield the desired result it can be repeated as often as necessary by using the following possible options to better restore the anatomy:

- Use of different lengths of trial heads.
- Exchange and replacement of the Trial Stem Proximal Part in situ with the other neck angle version of the proximal component (either 125° or 135°). The Trial Stem Proximal Part is replaced by first loosening and removing the Trial Stem Screw (Fig. 8a). The proximal component can then be removed with the Extractor for the Proximal Trial Stem (Fig. 8b).
- Changing the anteversion by rotating the Trial Stem Proximal Part only. This can be done in situ by loosening the Trial Stem Screw and rotating the Trial Stem Proximal Part until the desired anteversion is reached.
- Proceeding with the next diameter Reamer after removing the trial stem assembly and repeating the trial step with the appropriately sized trial stem assembly.

The trial reduction is repeated as often as necessary until optimal offset, leg length, range of motion, and stability are achieved. When satisfactory offset, leg length, range of motion, and stability have been achieved, dislocate the hip and remove the trial components.

The trial stem assembly can be removed as an assembly by using the Extractor (Fig. 9). The assembly can also be removed in two steps by first removing the Trial Stem Proximal Part with the Extractor for Proximal Trial Stem and the Trial Stem Distal Part with the Extractor for the Distal Stem (Fig. 10).



Fig. 8a



Fig. 8b



Fig. 10



Fig. 9

### Insertion of the Stem

Insert the prosthesis of the appropriate size by hand until resistance can be felt (Fig. 11).

The Impactor is used for final seating of the *Wagner Cone Prosthesis Stem* by mallet taps. The tip of the Impactor is inserted into the impacting hole in the shoulder of the prosthesis so that the fork-shaped flange surrounds the neck of the prosthesis (Fig. 12). The prosthesis can be rotated into the desired anteversion and impacted into its definitive position with a few moderate mallet blows. The depth of penetration according to the preoperative planning is verified.

When there is pre-existing anteversion, ensure that the neck of the prosthesis does not sit on the rim of the femoral neck cortex. If necessary, some bone may be removed with a fine chisel until there is a gap between the neck of the prosthesis and the bone.

The intermediate spaces remaining between the prosthesis and the proximal bone are packed tightly with the chips of cancellous bone which have been obtained during the procedure.



Fig. 11



Fig. 12

Once the implant is fully seated in the femoral canal, place the selected Femoral Head Provisional onto the taper of the implant (Fig. 13). Perform a final trial reduction to assess joint stability, range of motion, and restoration of leg length and offset. When the appropriate femoral head implant is confirmed, remove the Femoral Head Provisional and check to ensure that the 12/14 taper is clean and dry. Place the selected femoral head on the taper and secure it firmly by twisting it and striking it once with the Head Impactor. Proper engagement of the taper mechanism is related only to the force of impaction of a single blow. Successive impaction blows may either disrupt the Morse taper bond or risk femoral fracture. Test the security of the head fixation by trying to remove the head by hand.

Reduce the hip and assess leg length, range of motion, stability, and abductor tension for the final time.

### Wound Closure

After obtaining hemostasis, close the wound per surgical technique, and if appropriate, insert a *Hemovac*® Wound Drainage Device.

## Postoperative Management

The postoperative management of patients with a *Wagner Cone Prosthesis* Hip Stem is determined by the surgical approach and the surgeon's preferred postoperative protocol.



Fig. 13

## Case Studies

### Case 1

Original version of the *Wagner Cone Prosthesis Hip Stem*



Advanced and very painful dysplastic arthritis of the left hip in a 39-year-old woman.



3 weeks after implantation of the *Wagner Cone Prosthesis Stem* and a conical screw cup.



7 years after implantation of the prosthesis. There is normal free-of-pain function and the bone structure is homogeneous with structural adaptation to the mechanical loading.

### Case 2

Current version of the *Wagner Cone Prosthesis Hip Stem*



Preoperative



Postoperative (A/P view)



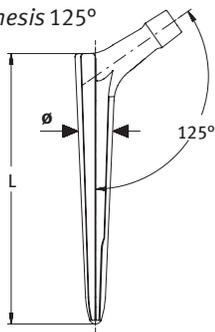
Postoperative (M/L view)

## Implants



Wagner Cone Prosthesis 125° Hip Stem

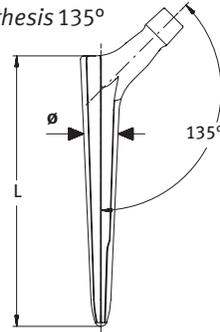
Protasul-64 Alloy  
12/14 Taper  
Uncemented



STERILE R

Wagner Cone Prosthesis 135° Hip Stem

Protasul-64 Alloy  
12/14 Taper  
Uncemented



STERILE R

ø mm	L mm	Offset mm	REF
13	115.0	27.5	01.00561.213
14	125.5	31.7	01.00561.214
15	125.7	32.5	01.00561.215
16	125.9	33.4	01.00561.216
17	126.2	34.2	01.00561.217
18	126.4	35	01.00561.218
19	126.6	35.9	01.00561.219
20	126.8	36.7	01.00561.220
21	127.0	37.5	01.00561.221
22	127.2	38.3	01.00561.222
23	127.4	39.2	01.00561.223
24	127.6	40	01.00561.224

ø mm	L mm	Offset mm	REF
13	115.0	26.2	01.00561.313
14	125.5	29.7	01.00561.314
15	125.7	30.4	01.00561.315
16	125.9	31.1	01.00561.316
17	126.2	31.8	01.00561.317
18	126.4	32.5	01.00561.318
19	126.6	33.2	01.00561.319
20	126.8	33.9	01.00561.320
21	127.0	34.7	01.00561.321
22	127.2	35.4	01.00561.322
23	127.4	36.1	01.00561.323
24	127.6	36.8	01.00561.324

## Instruments



Description	REF
Tray for <i>Wagner Cone Prosthesis</i> Instruments (complete)	01.00369.010
Tray base for <i>Wagner Cone Prosthesis</i> Instruments (empty)	01.00369.011
Tray insert for <i>Wagner Cone Prosthesis</i> Instruments (empty)	01.00369.012
Standard tray cover, grey	01.00029.031



Description	REF
Handle with quick coupling	75.00.25



Description	REF
Gauge for the medullary cavity	75.11.40-01a



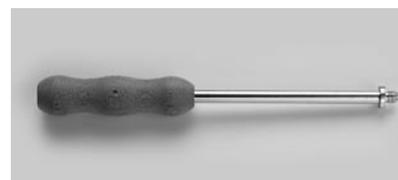
Description	REF
Extractor for <i>Wagner Cone Prosthesis</i> Stem	75.11.00-09



Reamer	REF
ø mm	REF
13	75.11.15-130
14	75.11.15-140
15	75.11.15-150
16	75.11.15-160
17	75.11.15-170
18	75.11.15-180
19	75.11.15-190
20	75.11.15-200
21	75.11.15-210
22	75.11.15-220
23	75.11.15-230
24	75.11.15-240



Description	REF
Impactor	75.11.15-01



Description	REF
Reduction lever	75.01.38

Description	REF
Tray trial stems (complete)	01.00568.100
Tray base trial stems (empty)	01.00568.100
Tray insert trial stems (empty)	01.00568.101
Standard tray cover, grey	01.00029.031

**Trial stem proximal part 125°**

ø mm	REF
13	01.00569.213
14	01.00569.214
15	01.00569.215
16	01.00569.216
17	01.00569.217
18	01.00569.218
19	01.00569.219
20	01.00569.220
21	01.00569.221
22	01.00569.222
23	01.00569.223
24	01.00569.224

**Trial stem proximal part 135°**

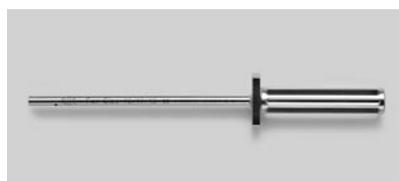
ø mm	REF
13	01.00569.313
14	01.00569.314
15	01.00569.315
16	01.00569.316
17	01.00569.317
18	01.00569.318
19	01.00569.319
20	01.00569.320
21	01.00569.321
22	01.00569.322
23	01.00569.323
24	01.00569.324

**Trial stem distal part**

ø mm	REF
13	01.00569.113
14	01.00569.114
15	01.00569.115
16	01.00569.116
17	01.00569.117
18	01.00569.118
19	01.00569.119
20	01.00569.120
21	01.00569.121
22	01.00569.122
23	01.00569.123
24	01.00569.124



Description	REF
Screw for trial stems (4 units in the tray)	01.00569.001



Description	REF
Impactor/ Extractor for distal trial stem	01.00569.010



Description	REF
Extractor for proximal trial stem	01.00569.011



Description	REF
Impactor/ Extractor	75.00.36



Description	REF
Extractor	75.85.75



Description	REF
Screwdriver	109.02.030

## Literature

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