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Nota Bene

The surgical technique described in this pamphlet illustrates the authors' suggested treatment for the uncomplicated procedure. In the final analysis, the surgeon needs to determine which procedure addresses the needs of each patient best.

Introduction And Product Description

The NANOS® femoral neck prosthesis provides metaphyseal anchoring and load transfer. The implant requires a gentle and minimal bone resection. The cancellous bone around the metaphysis and the greater trochanter are retained to ensure load distribution and transfer. This upholds the principle of the «second line of defense» for this prosthesis concept.

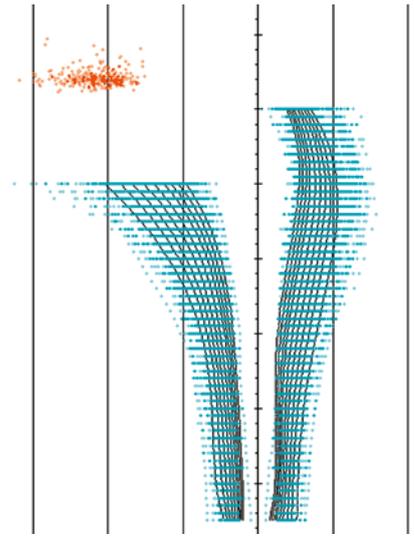
Precisely matching sizes as well as a clearly structured assortment of instruments make it easier to determine and select the suitable implant intraoperatively.

A total of ten fully compatible sizes are available, designed to complement each other. This guarantees individual and ideal selection of sizes both for preoperative planning and intraoperative application. The part of the femoral neck below the conus has been tapered to increase the range of motion.

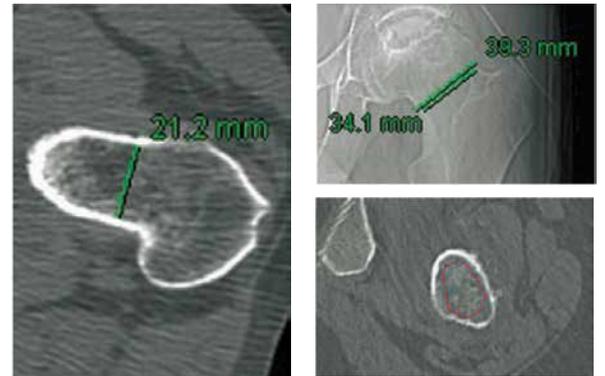
The development is based on past clinical experience of various short stem prostheses, biomechanical explorations and physiological optimization. NANOS® is the third generation of this type of prosthesis.



In the development of the NANOS® femoral neck prosthesis, 565 CTs of patients under the age of 65 years have been assessed. The analysis included determining the internal cortical geometries both medial and lateral and the position of the ball head while maintaining the rotation center. The concept of the prosthesis is to have as long as possible an attachment in the region of the calcar in order to ensure optimum load transfer and to have a cortical attachment in the distal-lateral side to support and compensate loads in the varus direction.



Cortical support in the axial view is also very important with short-stem prostheses. Over 50 CT images were assessed to measure the region of the femoral neck from just subcapital down to the greater trochanter towards the femoral neck level. The isthmus was determined and measured in two levels to allow far proximal cortico-cancellous anchorage. The CT images were also used to define the transverse geometry, allowing the cortical ring to be fully retained at the circumferences, and to ensure a uniform load transfer.



The materials selected for the NANOS femoral neck prosthesis are also state-of-the-art. The implant is made of a proximal osteoconductive coated titanium forged-alloy (ISO 5832-3). The surface roughness of the titanium plasma coating on one hand increases the surface area and on the other ensures superior primary stability due to the interlinking. The titanium plasma coating is additionally equipped with calcium phosphate (BONIT®) which accelerates the osseointegration process even more.



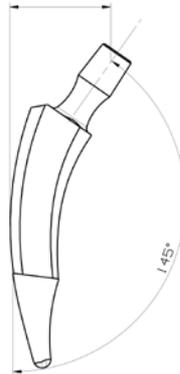
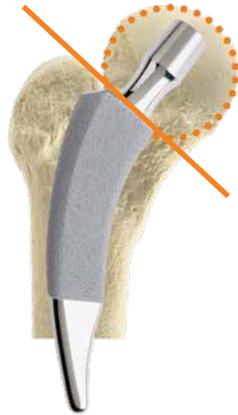
Femoral Neck Preservation

The resection is done with maximum bone retention with a straight cross-cut osteotomy of the femoral neck. The arched stem follows the cancellous channel of the femoral neck into the femur and thus accommodates anatomical anteversion and retroversion as well as varus and valgus position of the femoral neck.

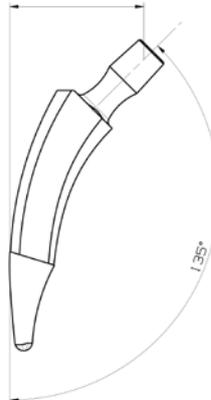
Retention of femoral neck = retention of offset

As illustrated below, NANOS° size 3 allows for CCD angles of 125° to 145°.

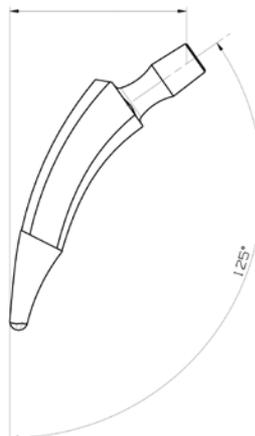
Coxa valga



Coxa normala



Coxa vara



Indications For The Use Of NANOS[◊] Femoral Neck Prosthesis

- Primary and secondary coxarthrosis
- Dysplasia coxarthrosis
- Avascular and post-traumatic femoral head necrosis
- Patients with good bone density and intact femoral neck

Contraindications For The Use Of NANOS[◊] Femoral Neck Prosthesis

- Marked osteoporosis
- Previous surgeries that no longer guarantee the planned support
- Marked coxa valga
- Marked coxa vara with an implant position $< 125^{\circ}$

Risk Factors That May Affect Surgical Success

Potential risk factors related to this procedure are:

- Obesity (body mass index BMI > 30)
- Extreme anticipated stress (e.g., sports or work), especially with patients who weigh more than 220 lbs (100 kg)
- Bone metabolism disorders (osteoporosis, osteomalacia)
- Appearance of fissures, in rare cases fracture of the femur
- Circulatory disorders of the affected extremity
- Neurological disorders of the affected extremity
- Muscular malfunctions of the affected joint
- Obesity
- Alcoholism and drug abuse
- Patients with psychiatric disorders or addictions
- Pregnancy
- Growth in children and juveniles
- Extreme anticipated stress from work or sports
- Epilepsy or other causes of frequent accidents with an increased risk of fractures
- Joint deformities that make anchoring the implant more difficult
- Weakening of the supporting structures through tumors
- Intake of high doses of cortisone or cytostatic drugs
- Past or pending infectious diseases with possible joint manifestation
- Deep vein thrombosis and/or pulmonary embolism in patient history
- All general surgery risks

Surgical Technique

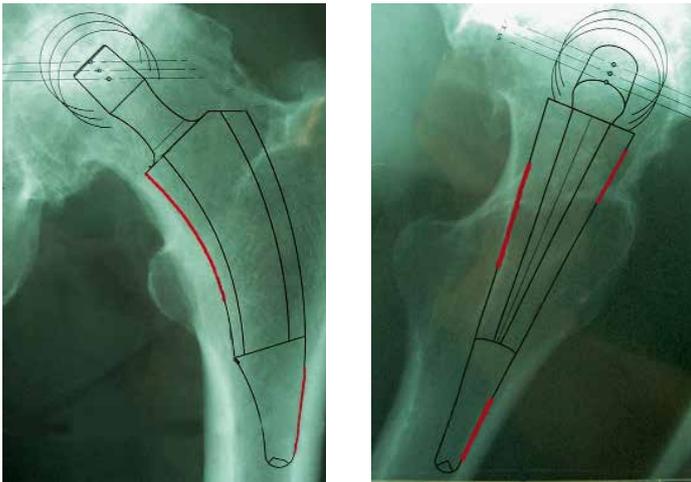
The information provided under surgical technique is intended as recommendations and references. However, the detailed application or feasibility of application depends on the skill and experience levels of the individual practitioner.

For detailed information about the implant system and the instruments please refer to their respective instructions for use.

Preoperative Planning

X-ray templates with 15% enlargement in analogous form are available for preoperative planning. As a standard, digital x-ray templates with a scale of 1:1 for use with the planning software MediCAD* are also available for download. The following illustration shows the preoperative planning for the NANOS° femoral neck prosthesis.

The size and position of the prosthesis are planned using the anterior/ posterior and the axial x-ray image. Depending on the system requirements, attachment is advised in the anterior/posterior region on the calcar femorale and the lateral corticalis. In the axial x-ray a proximal pressfit in the ventro/dorsal region and support of the distal tip of the prosthesis is achieved. Leg length and offset can be adjusted during the planning by setting the resection height and the appropriate choice of prosthesis.



Example of preoperative planning for the NANOS° femoral neck prosthesis

**Upon request, the manufacturer OHST Medizintechnik AG, Rathenow will provide digital x-ray templates in databases of other providers for the digital planning software.*

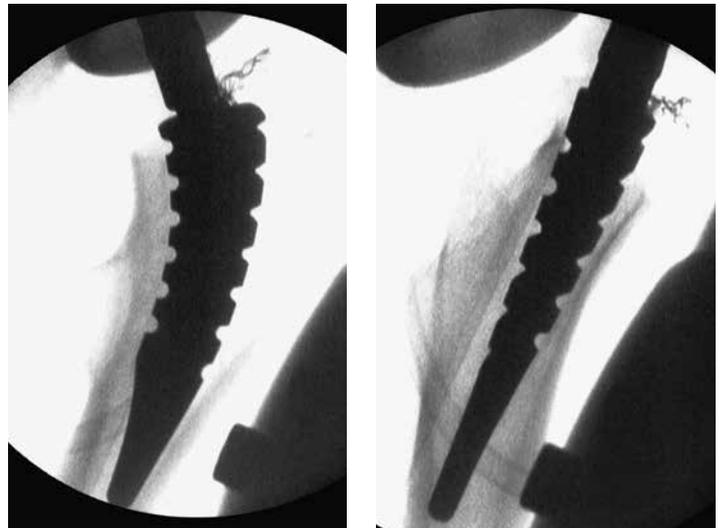
Case studies

Case 1

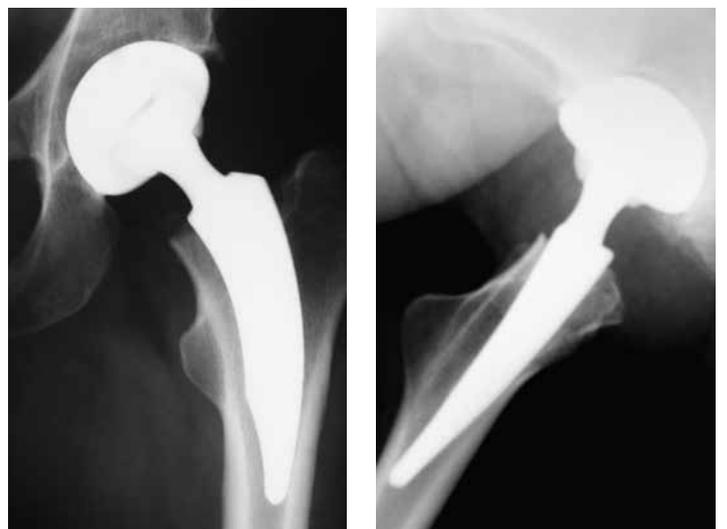
S. R., 49 years of age, female



Intraoperative sizing and x-ray control of the compactor.



Postoperative x-ray. Good position of the NANOS® femoral neck prosthesis.



Case 2

Left: E. M., 49 years of age, male

Right: Postoperative x-ray. Good position of the NANOS° femoral neck prosthesis.



Case 3

S. H., 48 years of age, male



Postoperative x-ray. Good position of the NANOS° femoral neck prosthesis.



Surgery Step 1

Resection of the femoral neck

A maximum amount of bone is preserved during the resection of the femoral neck, in accordance with the planning. Usually 0.5 – 1.0 cm subcapital with a straight transverse osteotomy of the femoral neck.



Surgery Step 2

Preparing the prosthesis site

The opening rasp is used to prepare the path for the forming rasps. The opening rasp is inserted with a slight curved motion inside the interior cortex until the lateral cortical bone is reached at the height of the bottom edge of the lesser trochanter.



For minimally invasive preparation, the size 0 rasp is connected to the curved rasp handle and moved forward along the calcar ridge. This rasp can later be used for the finishing preparation at the lateral cortical ring.



This is followed by finishing with the cancellous compactors. The aim of the preparation with compactors is to compact cancellous bone.

The preparation is carried out in stages until the planned size is reached or until the compactor is in cortical contact in the load-bearing zones. Cortical contact can be determined by mechanical stability and when the sound changes.

The rasps or compactors should be used in a slightly curved motion to ensure that there are no gaps that won't be filled by the prosthesis. The compactor should be beyond or flush with the resection line. If needed, the next size will be fitted.

Note

Rasps of all sizes can be used for individual applications as desired.



Surgery Step 3

Trial positioning

Once the correctly fitting compactor is properly positioned, remove the rasp handle and add the trial head. Next the trial positioning takes place. The range of motion should be checked for possible restrictions, along with clinical review of telescoping and leg length.

Trial heads are available in diameters of 22*, 28, 32 and 36 mm with a neck length of S, M, L and XL*.

**optional*

It is advisable to carry out a C-arm check in repositioned condition to assess fit, rotation center and offset of the implants.

Removal of the trial head and compactor.

If needed, rework the prosthesis site with the rasps and a larger compactor. Lateral, between the compactor and the cortical femoral neck ring where a bone conflict can occur should the opening rasp be used, until the compactor can be put in place with the desired fit.



Surgery Step 4

Implanting the stem

Manually insert the NANOS° original prosthesis that corresponds to the size of the last used compactor. Subsequently impact it to the same depth as the compactor had previously, using the inserter.

Carefully clean the conus, position and impact the original ball head. Reposition, check stability and movement.

The wound is sutured in the standard way according to the surgeon's preference.

Prosthesis Removal

If it is necessary to intraoperatively remove a NANOS° original prosthesis, the provided extraction instrument can be used.

This can be fitted to the cone and connected to the rasp handle to remove the implant.



Postoperative Treatment

The follow-up treatment depends on the surgery outcome. Mobilization can be started very quickly after a minimally traumatic implantation. The postoperative procedure with partial or full load bearing, walking aids, three point gait, four point gait will be determined by the surgeon or the person in charge of postoperative treatment on an individual basis. The bone quality and condition of the patient should be taken into consideration. Directed behavior, muscle building through physiotherapy and gait training have a positive impact on the postoperative course.

Notes Regarding Implant Unpacking

The implants are packaged in 3 layers of clear pouches made of plastic film (radiation sterilization 25 kGy minimum) with cardboard. The outer pouch of the 3-layer clear pouch packaging should be removed together with the cardboard by non-sterile staff. The second pouch should be opened in a manner that will not endanger the sterility of the inner pouch. The innermost pouch will be pulled out and opened by sterile staff. The implant needs to be handed to the surgeon in this way to enable direct removal of the sterile implant.

Implants

NANOS[◊] femoral neck prosthesis (ISO 5832-3 Ti6Al4V, TPS/Bonit[®])

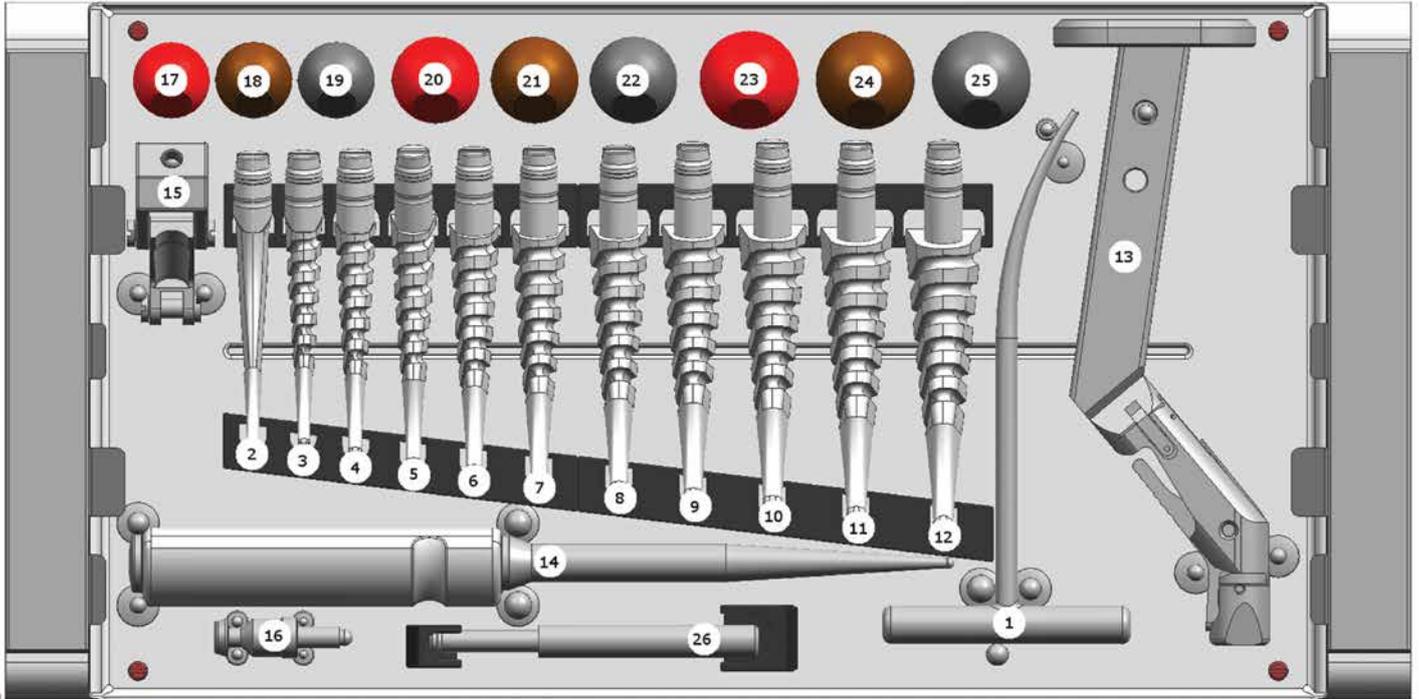
Implants		Art. No.	SAP No.
NANOS [◊] femoral neck prosthesis size 0	ISO 5832-3 Ti6Al4V, TPS/Bonit	425000	7500-8154
NANOS [◊] femoral neck prosthesis size 1	ISO 5832-3 Ti6Al4V, TPS/Bonit	425001	7500-8155
NANOS [◊] femoral neck prosthesis size 2	ISO 5832-3 Ti6Al4V, TPS/Bonit	425002	7500-8156
NANOS [◊] femoral neck prosthesis size 3	ISO 5832-3 Ti6Al4V, TPS/Bonit	425003	7500-8157
NANOS [◊] femoral neck prosthesis size 4	ISO 5832-3 Ti6Al4V, TPS/Bonit	425004	7500-8158
NANOS [◊] femoral neck prosthesis size 5	ISO 5832-3 Ti6Al4V, TPS/Bonit	425005	7500-8159
NANOS [◊] femoral neck prosthesis size 6	ISO 5832-3 Ti6Al4V, TPS/Bonit	425006	7500-8160
NANOS [◊] femoral neck prosthesis size 7	ISO 5832-3 Ti6Al4V, TPS/Bonit	425007	7500-8161
NANOS [◊] femoral neck prosthesis size 8	ISO 5832-3 Ti6Al4V, TPS/Bonit	425008	7500-8162
NANOS [◊] femoral neck prosthesis size 9	ISO 5832-3 Ti6Al4V, TPS/Bonit	425009	7500-8163

BONIT[®] is a Registered Mark from DOT (Medical Implant Solutions).

Instrumentation

NANOS[®] instrument tray (Set SAP No. 75200170)

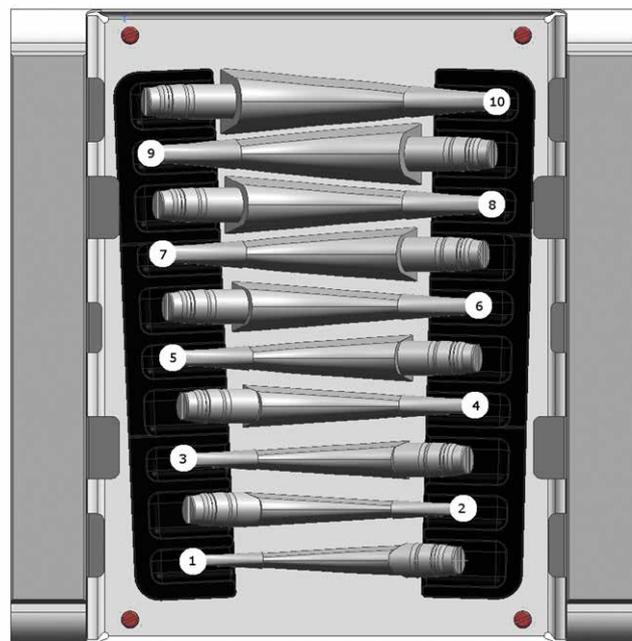
No.	Description	Art. No.	SAP No.
1	Opening rasp 90° rotated	506-1155	7500-8173
2	NANOS [®] rasp size 0	506-1170	7500-8185
3	NANOS [®] compactor size 0	506-1160	7500-8175
4	NANOS [®] compactor size 1	506-1161	7500-8176
5	NANOS [®] compactor size 2	506-1162	7500-8177
6	NANOS [®] compactor size 3	506-1163	7500-8178
7	NANOS [®] compactor size 4	506-1164	7500-8179
8	NANOS [®] compactor size 5	506-1165	7500-8180
9	NANOS [®] compactor size 6	506-1166	7500-8181
10	NANOS [®] compactor size 7	506-1167	7500-8182
11	NANOS [®] compactor size 8	506-1168	7500-8183
12	NANOS [®] compactor size 9	506-1253	7501-8378
13	Rasp handle, curved	506-1169	7500-8184
14	NANOS [®] impactor with silicone	7510-2877	7510-2877
15	Stem extractor	506-073	7500-8168
16	Handle adapter, hook coupling	506-075	7500-8169
17	Trial head 28 S/+0	512-381	7502-9375
18	Trial head 28 M/+4	512-382	7503-0221
19	Trial head 28 L/+8	512-383	7502-9376
20	Trial head 32 S/+0	512-387	7503-0259
21	Trial head 32 M/+4	512-388	7502-9380
22	Trial head 32 L/+8	512-389	7502-9381
23	Trial head 36 S/+0	512-393	7502-9385
24	Trial head 36 M/+4	512-394	7502-9386
25	Trial head 36 L/+8	512-395	7502-9387
26	Alignment rod Ø8mm	506-015	7500-8164
	NANOS [®] tray	7510-2876	7510-2876
	Lid for tray	7510-2521	7510-2521



Optional instruments

NANOS[°] tray rasps (Set SAP No. 75210420)

No.	Description	Art. No.	SAP No.
1	NANOS [°] rasp size 0	506-1170	7500-8185
2	NANOS [°] rasp size 1	506-1418	7502-9226
3	NANOS [°] rasp size 2	506-1419	7502-9227
4	NANOS [°] rasp size 3	506-1420	7502-9228
5	NANOS [°] rasp size 4	506-1421	7502-9229
6	NANOS [°] rasp size 5	506-1422	7502-9230
7	NANOS [°] rasp size 6	506-1423	7502-9231
8	NANOS [°] rasp size 7	506-1424	7502-9232
9	NANOS [°] rasp size 8	506-1425	7502-9233
10	NANOS [°] rasp size 9	506-1426	7502-9234
	NANOS [°] tray rasps	7510-3006	7510-3006
	Lid for tray	7510-2898	7510-2898



Description	Art. No.	SAP No.
Rasp handle, double offset, right, hook coupling	367-155	7510-3113
Rasp handle, double offset, left, hook coupling	367-156	7510-3114
IMT rasp adapter, double offset, right, hook coupling	367-158	7510-3115
IMT rasp adapter, double offset, left, hook coupling	367-159	7510-3116
NANOS° IMT rasp adapter, spring hook	506-1210	7509-4887
Rasp handle, spring hook, medial release mechanism	506-1245	7503-0476
NANOS° rasp handle, spring hook, straight	506-1204	7509-4886
Femoral rasp, silicone handle	506-071	7510-3084

X-ray templates

Description	Lit. No.
X-ray template NANOS° femoral neck prosthesis ø28	09777
X-ray template NANOS° femoral neck prosthesis ø32	09778
X-ray template NANOS° femoral neck prosthesis ø36	09779

Notes

A series of horizontal dotted lines for taking notes.

Manufacturer

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