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Wagner Cone Prosthesis® Hip Stem

Surgical Technique



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This surgical technique was developed in conjunction with heath care professionals.

Introduction

History

- **1990:** First implantation
- **1992:** Market introduction
- **2006:** Slight design modification

  (no design change on the zone of primary fixation):

  – Enlarged proximal shoulder with ribs till the tip of the shoulder for a bigger surface of osseo integration

  – Slim neck and short cone for a better range of motion

- **2006:** Additional offset version 125° to better restore the anatomy



1990–2006



From 2006 Wagner Cone Prosthesis 125° and 135°

Design Features

- Uncemented implant with free setting of antetorsion
- Designed for difficult bone conditions at the proximal end of the femur and for CDH cases
- Tapered shape with an angle of 5 degrees for press-fit fixation
- 8 longitudinal ribs for rotational stability
- Standard and offset version for a better restoration of the anatomy



Wagner Cone Prosthesis Hip Stem

The Wagner Cone Prosthesis Stem is designed for uncemented fixation in difficult bone conditions at the proximal end of the femur and for CDH cases.

The surface of the prosthesis is rough blasted which, together with the characteristic shape, promotes bony apposition over a large area.[1]

The circular tapered stem is not subject to any rotation force during insertion, i.e. the angle of antetorsion can be determined by the surgeon. The stem has 8 longitudinal ribs. The relatively sharp ridges of the ribs cut into the bone, thus allowing for optimal rotational stability.[2] This also explains the fact that the typical thigh pain associated with some uncemented prosthetic systems is practically unknown with the Cone Prosthesis.

In addition to providing rotational stability, the sharp longitudinal ribs of the stem are also beneficial for bony apposition. Schenk's[1] investigations have shown very clearly that bone forms and attaches preferentially on the sharp-edged prominences of the implant and less in the hollows of the surface.

In order to achieve a broad-based support of the prosthesis in the region of the calcar, the medial rib is inserted distally to this area into the convex support surface. The ribs on the lateral part start from the tip of the shoulder in order to ensure the greatest possible area of contact in the trochanter. This provides rotational stability and improves osseointegration. As the CCD angle and the offset are not constant values, the Wagner Cone Prosthesis Stem is now available in 2 different CCD angles, 125° and 135°. This provides a wider range of offset options, which allows an adequate restoration of biomechanical parameters, as the center of rotation, the CCD angle and the leg length.

Both versions are available in 12 diameters from 13 to 24 mm to fit the individual width of the medullary canal.



Reamer

Trial Stem

Instruments

Surgeons have a set of user-friendly instruments at their disposal for implantation of the Wagner Cone Prosthesis Stem. The core instruments are reamers which are used for the careful preparation of the medullary canal as well as modular trial stems used for determining the most adapted Wagner Cone Prosthesis Stem version and the best-suited size of implant.

Reamers

The Wagner Cone Prosthesis Stem, with its circular cross-section, is indicated particularly for slender configurations of the proximal femur, as well as for cases involving pathologic morphology. When these indications are present, an important focus should be placed on the preparation of the medullary canal in the most bone preserving manner. The use of reamers allows the surgeon to prepare the medullary canal with care and precision, even in cases of poor bone quality of the proximal femur where the use of rasps is not an option.

Modular Trial Stems

Trial stems are used to determine the exact positioning and correct size of the final implant. The trial stems of the Wagner Cone Prosthesis Implant are modular with one distal part for each size and two different proximal parts, 125° and 135°, per size. This allows maximal intra-operative flexibility during trial reduction. The proximal part can be exchanged in situ leaving the distal part in the bone to avoid damage to the bone.

Please note that the distal parts 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 trial procedure. The trial stem may be inserted as far as the intended anchoring depth of the implant to assess accurately the tension of the soft tissue, range of motion and degree of antetorsion.

INDICATIONS

The Wagner Cone Prosthesis Hip Stem is designed for cylindrical proximal femoral bone that could fracture when conventional flared stems are used. The Wagner Cone Prosthesis Stem is also designed for deformities of the femur where fixation of conventional stems is problematic. Specifically, the Wagner Cone Prosthesis Stem is indicated when the following factors are present:

1. Cylindrical configuration of the proximal medullary cavity where insertion of conventionally shaped prosthetic stems causes problems. These conditions are found especially with congenital dysplasia of the hip (CDH) and coxa vara congenita; they are also found with a very delicate bone structure, frequently in combination with coxa valga.

2. Increased antetorsion of the femoral neck, e. g. CDH, where the cross-section of the proximal medullary cavity is anteverted even after resection of the femoral neck, forcing prosthetic stems with a flat or transverse oval profile into antetorsion. With the circular cross section of the Wagner Cone Prosthesis Stem, the angle of antetorsion can be adjusted as desired.

3. Deformities and intramedullary bony scarring of the proximal end of the femur after osteotomies, fractures and growth disorders or congenital deformities. Preparing the medullary cavity to receive the prosthesis with conventional reamers can be very tedious or even impossible, whereas preparation with the conical reamer of the Wagner Cone Prosthesis Stem can be carried out more easily and safely.

CONTRAINDICATIONS

The first contraindication is the trumpet-shaped proximal widening of the medullary cavity where no support for the prosthetic stem in its middle and proximal thirds is available. In addition the Wagner Cone Prosthesis Stem should not be considered when there is considerable weakening of the bone structure at the proximal end of the femur.

Preoperative Planning

The preoperative planning follows standard procedures. A good quality X-ray template is essential. The first step in planning consists in selecting suitable implants for the acetabulum and the femur using the X-ray templates on the original X-ray films.

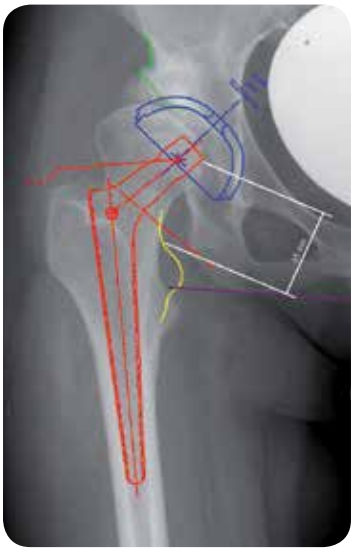
When selecting the size of the Wagner Cone Prosthesis Stem it is important that the configuration of the femur allows close contact between the middle third of the prosthetic stem and the cortex, and not just that the tip of the stem fits tightly in the medullary cavity.

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

In choosing the diameter, it must be remembered that reaming with the reamer 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.

Furthermore, the most adapted version of the Wagner Cone Prosthesis Stem (125° or 135°) to best restore the offset, the center of rotation and the CCD angle is selected.

Planning drawing: On the outline drawing of the pelvis, the position of the cup implant with the center of rotation is first sketched and the current and desired position of the tip of the trochanter is marked in order to check the leg length.



Preoperative planning with digital templating



Postoperative

Using the X-ray template, the outline of the selected Wagner Cone Prosthesis Stem is then transferred to the planning sketch and the line of resection is also drawn from the template. The planning sketch is now laid on the X-ray film and the outline of the femur is transferred carefully. The tip of the greater trochanter on the X-ray is at the level of the previously made marking for the desired trochanter position.

Finally, the distance between the cone of the stem and the proximal limit of the lesser trochanter is measured. In reconstructing deformed hip joints, further marking points can be given and their distances measured. All longitudinal measurements must be made according to the scale on the template as this takes into account the degree of magnification of the X-ray. All measurements should be entered on the planning sketch so that they can be referred to during the operation.

Surgical Technique

The Wagner Cone Prosthesis Hip Stem can be implanted using all of the usual surgical approaches. However, posterior access with the patient in the lateral position is particularly suitable: the reamer for the Wagner Cone Prosthesis Implant has a straight stem which is introduced into the axis of the medullary cavity. With the posterior approach, when the hip and knee are flexed, the way to the medullary cavity is free without the need for temporary removal of the greater trochanter and without the instrument exerting pressure on the muscles.

With the lateral, transgluteal and anterior approaches, retraction of the muscles is more difficult. Moreover, with the posterior approach, the incision is smaller and there is less blood loss with the patient in the lateral position. This appears particularly apparent in obese patients.

The incision or resection of the posterior joint capsule is a critical issue in the posterior approach. Posterior dislocation of the prosthesis can occur more readily during the healing phase, if the cup and/or the stem are placed in insufficient anteversion. This problem can be minimized with a trial reduction with the trial stems before definitive implantation of the Wagner Cone Prosthesis Hip Implant. But nonetheless, this phenomen requires particular care.





Figure 1

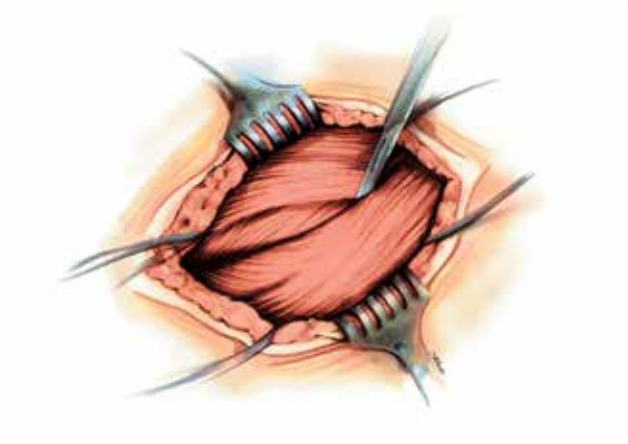


Figure 2

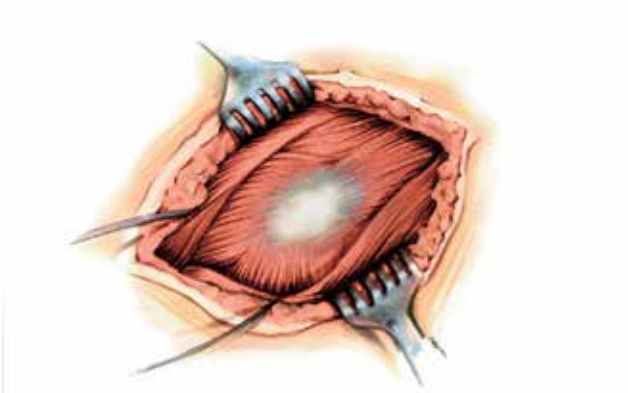


Figure 3

Posterior Approach

Positioning of the Patient and Incision

Place the patient in lateral position. The skin incision is 3 cm posterior to the intertrochanteric ridge, running in the direction of the fibers of the gluteus maximus and fascia lata.

The gluteus maximus and fascia lata are split in the direction of the fibers.

By retracting the gluteus maximus and fascia lata, the greater trochanter and short external rotators are exposed.

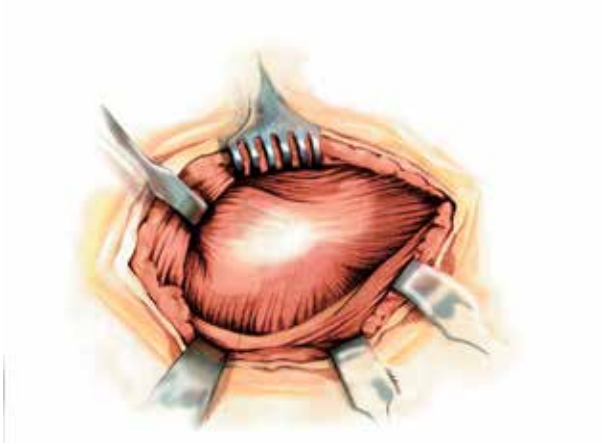


Figure 4

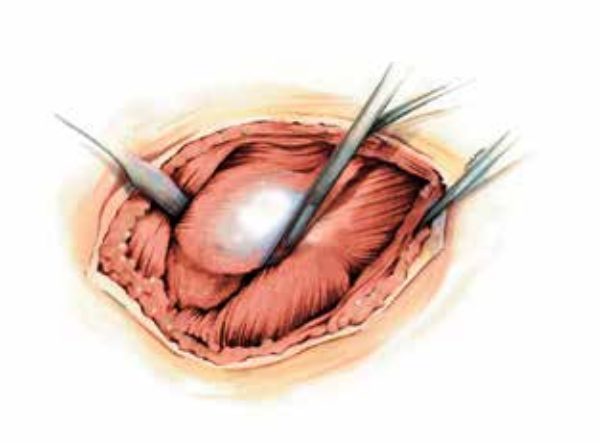


Figure 5

Positioning of the Patient and Incision (cont.)

The sciatic nerve is identified. Perineural adhesions can be resected. Division of the tendon of gluteus maximus is very rarely necessary.

The short external rotators including the piriformis muscle are detached from the greater trochanter. Slight internal rotation of the leg facilitates the dissection. The hip joint is then exposed.

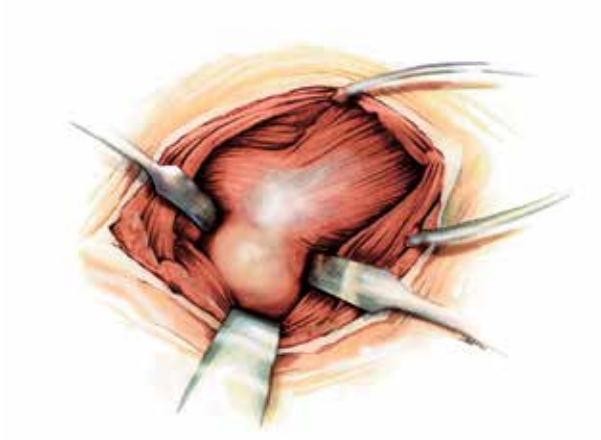


Figure 6

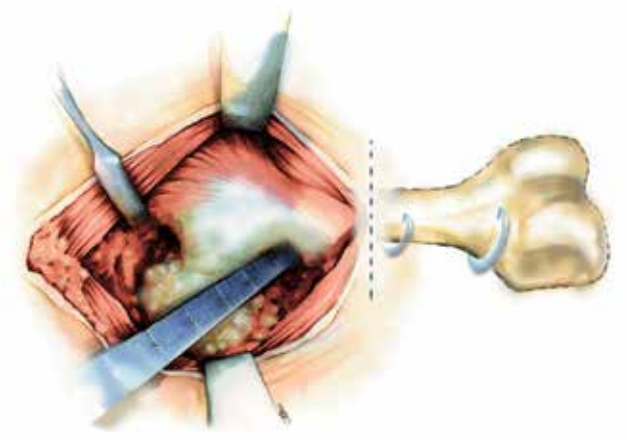


Figure 7

Positioning of the Patient and Incision (cont.)

After exposure of the hip joint, Hohmann retractors are inserted at the cranial and caudal margins of the femoral neck and the posterior hip capsule is incised or resected. Another Hohmann retractor with a sharp tip is then inserted under the posterior rim of the acetabulum.

Osteotomy of the Femoral Neck

The head of the femur can be carefully dislocated by a combined movement of internal rotation, flexion and adduction. The resection line is then marked according to preoperative planning and considering the deformity of the femur.

If dislocation cannot be achieved, even after further soft tissue detachment, an in situ osteotomy of the femoral neck is performed.

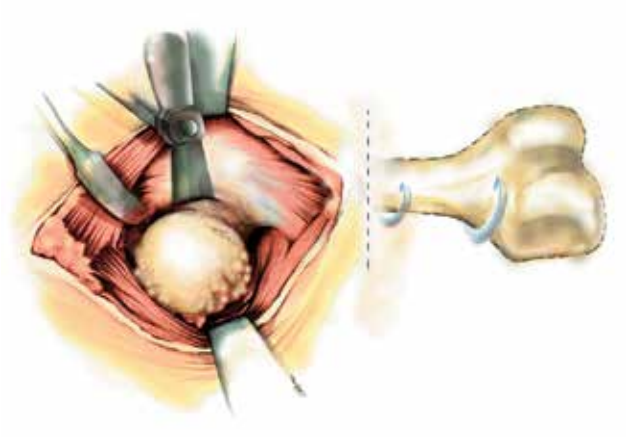


Figure 8

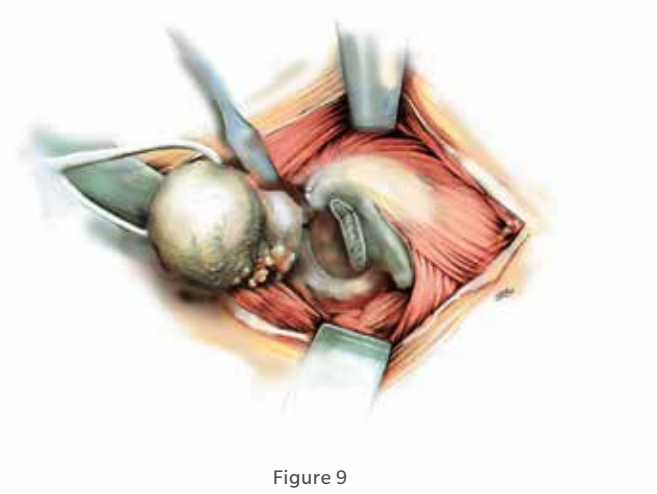


Figure 9

Osteotomy of the femoral neck at the marked site is performed. The osteotomy with the oscillating saw should involve only the medial 2/3 of the cross section of the femoral neck so that the saw does not run into the greater trochanter. The remaining third is divided with a chisel along the medial surface of the trochanter in the direction of the femoral shaft.

Remove the femoral head. Insert a retractor at the anterior rim of the acetabulum to expose the entire rim of the acetabulum. Proceed at this point with the preparation of the acetabulum.

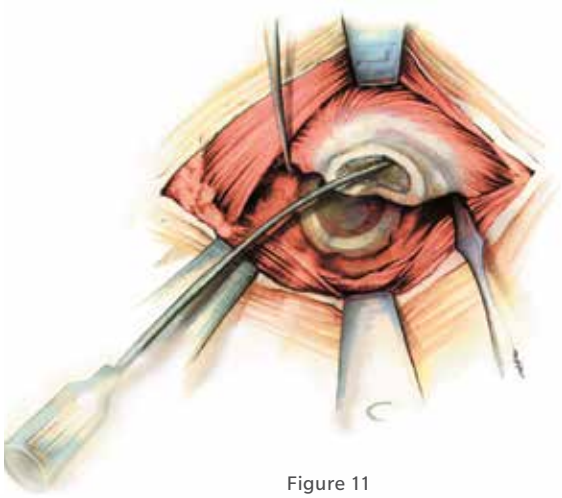


Figure 11

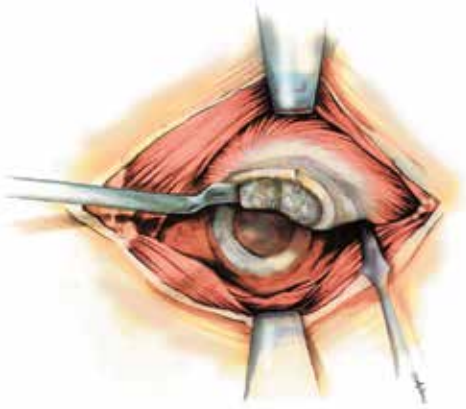


Figure 10

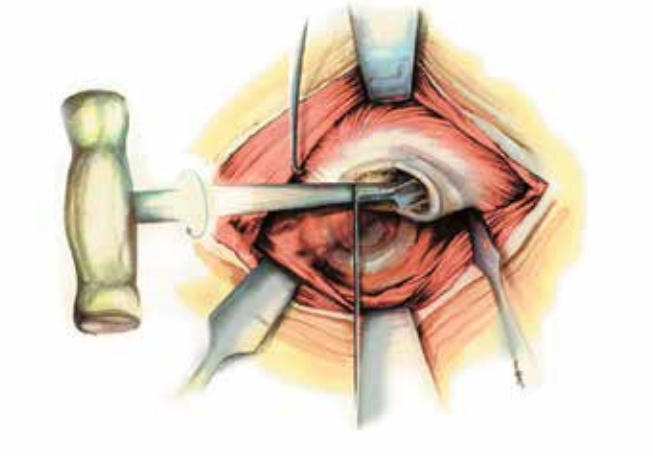


Figure 12

Osteotomy of the Femoral Neck (cont.)

Explore the medullary cavity with the medullary cavity gauge. This is used mainly to check that there is free access to the medullary cavity and locates any bony barriers.

Preparation of the Femoral Canal

Open the medullary cavity with a hollow chisel. At the same time, taking into account the planned antetorsion of 10–15°, the trochanter is grooved inside so that the reamer and prosthesis are not subsequently diverted in a varus direction. The cancellous bone is resected sparingly to allow enough room for the reamer.

The femoral medullary cavity is widened conically with the reamers in the lon- gitudinal direction of the femur until noticeable resistance is felt. The depth of penetration of the reamer is checked with a Kirschner wire which is placed on the tip of the greater trochanter.

Note: Reaming can be performed under power (operating at ream speed). However, at a minimum, the final reamer size should be driven manually.



Figure 13a



Figure 13b



Figure 14

Trial Reduction with the Trial Stem

The diameter of the distal part of the trial stem corresponds to the last used reamer. The proximal part of the trial stem is selected according to the CCD angle defined in the preoperative planning, the size is chosen corresponding to the last used reamer.

It is recommended to assemble the trial stem outside of the body and to insert it as a monobloc. Mount the selected proximal and distal part of the trial stem together and tighten the two parts by inserting and tightening the screw for trial stems (Figure 13a and 13b). Insert the trial stem in the femur until it is properly seated (Figure 14).

When there is severe preexisting antetorsion, make sure that the prosthesis is placed in the corrected position so that the neck of the prosthesis is not sitting on the rim of the cortex of the femoral neck. If necessary, some bone must be removed with a fine chisel until there is a sufficient gap between the neck of the prosthesis and the bone.

Select the trial head size as templated and seat it onto the trial taper.

Next, the hip is reduced. Leg length, offset and range of motion are checked.



Figure 15a



Figure 15b



Figure 16



Figure 17

Trial Reduction with the Trial Stem (cont.)

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 proximal part of the trial stem in situ by the other version of the proximal part (either 125° or 135°). The proximal part is replaced by first untightening and removing the screw. The proximal part can then be removed with the extractor for the proximal parts and be replaced with the other version of proximal part (Figure 15a and 15b).
- Changing the antetorsion by rotating the proximal part only. This can be done in situ by untightening the screw and turning the proximal part until the desired antetorsion is reached.
- Proceeding with the next diameter reamer after removing the trial stem and repeating the trial step with the appropriately sized trial stem.

The trial reduction is repeated as often as necessary until optimal offset, leg length and stability are achieved.

The trial stem can be removed both as a monobloc assembly by using the extractor on the extractor hole (Figure 16) and in two steps, first removing the proximal part with the extractor for proximal parts and then the distal part with the extractor for distal parts (Figure 17).



Figure 18



Figure 19

Insertion of the Stem

Insert the prosthesis of the appropriate size by hand until resistance can be felt.

The impactor is used to ensure final seating of the Wagner Cone Prosthesis Stem by hammer taps. The spike 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. With this instrument, the prosthesis is rotated into the desired antetorsion and impacted into its definitive position with a few moderate hammer blows. The stability of the fixation can be assessed as follows: at first the prosthesis penetrates somewhat deeper into the medullary cavity with each hammer blow until the required stability is reached and the prosthesis does not move any further continuing hammer blows. At the same time, the sound of the hammer blows changes. Finally, the depth of penetration according to the preoperative planning is checked with the use of a tape measure.

When there is a preexisting antetorsion, make sure, that the neck of the prosthesis is not sitting on the rim of the cortex of the femoral neck. If necessary, some bone must be removed with a fine chisel, until there is a gap with approximately 3 mm wide and 10 mm deep between the neck of the prosthesis and the bone.



Figure 20

Insertion of the Stem (cont.)

For the final trial reduction, a trial head is seated on the stem taper. The hip is then reduced and examined by moving the leg in all directions, especially in flexion and internal rotation. Soft tissue tension is checked with longitudinal traction on the extended leg. If necessary, the prosthesis is re-implanted with adjusted angle of antetorsion and the trial reduction is repeated.

After redislocation, the intermediate spaces remaining between the prosthesis and the bone are filled tightly with the chips of cancellous bone which have been obtained during the dissection. With a very narrow femur, it must be ensured that the medial surface of the prosthetic neck does not lie on the cortex at the site of osteotomy of the femoral neck. If this is the case, the cortex must be removed with a fine chisel until there is a narrow space of at least 10 mm in depth between prosthesis and bone.

After carefully cleaning and drying the taper the selected femoral head is mounted with a rotational movement and rotated further with axial force until it is firmly seated.

The femoral head is seated with one light hammer blow on the head impactor in axial direction.

Upon reducing the joint, the function of the hip is assessed.

The short external rotators are refixed. The redon drain is inserted and the appropriate closure technique is performed.

Postoperative Treatment

The postoperative treatment depends upon the patient and the bone quality.

Below is an example of a post-operative treatment: After the operation, the affected leg is laid in a foam splint. Beginning on the first day after the operation, the patient is stood beside his bed three times a day. Walking exercises begin on the third postoperative day in the patient's room, and walking to the toilet and in the corridor commence on the fifth day. Partial weight-bearing with two crutches is checked on the scales.

Climbing stairs and isometric training of the hip muscles in the lateral and prone positions start on the fifteenth postoperative day. Getting into a car is practiced. The patient is discharged home after 3 weeks with instructions to continue partial weight-bearing and the isometric muscle exercises and to omit passive movement exercises.

The first follow-up examination takes place three months after the operation. Depending on the X-ray findings, there is usually a gradual transition to full weight-bearing within four weeks. Patients are advised against sporting activity for the next few months.

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