Revelation® Surgical Technique
Proper analysis of your patient’s needs and preoperative planning for regaining normal physiological function are the most important steps for surgical success.

Whether osteoarthritis, rheumatoid arthritis, avascular necrosis or revision surgery is the basis for your decision, Encore's offers the selection of implants you require to make your surgical decisions.
Let's get started

This surgical technique will answer your procedural questions on the instruments and implants in this system. Each step will explain how to get the very best results in implanting this device. Right approach, right hardware, let’s get started on the road to your patient’s recovery.

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This brochure is presented to demonstrate the surgical technique utilized by the surgeon listed above. Encore, as the manufacturer of this device, does not practice medicine and cannot recommend this or any other surgical technique for use on a specific patient. The choice of the appropriate surgical technique is the responsibility of the surgeon performing the operation.
Introduction

The Revelation Hip System is a unique system that represents a fundamental departure from the traditional way in which femoral stems have been designed. Unlike other hip systems, created to "answer" a specific clinical issue, the Revelation stem represents the necessary consequence of a multidisciplinary basic science investigation of joint biomechanics and bone morphology. It was developed through an international cooperative effort that included New York University, the University of London, the University of Rome, John Hopkins University, and Nagoya University of Japan. The Revelation Hip System is applicable for and its instrumentation designed to deal with both primary and revision surgery. It offers off-the-shelf product for the routine hip replacement as well as CAD/CAM capability for unusual anatomy and bone stock problems encountered with old trauma, osteotomies, CDH, and failed THR. The unique shape of the Revelation Hip Stem is designed to physiologically load the proximal femur. It has permitted immediate full weight bearing following primary hip replacement, facilitated recovery of function, and shortened hospital length of stay. More importantly, it has been shown to preserve 95 percent bone stock and in the case of prior bone loss, to encourage bone regeneration.

Design Rationale

Long-term success of a cementless femoral stem is determined by its ability to achieve a stable fixation in the bone. The requirements include inherent primary stability; physiologic load transfer to avoid stress shielding and the resulting bone resorption; and prevention of micromotion between the stem and the bone which may lead to loosening of the prosthesis and thigh pain. A design based on more complete understanding of hip biomechanics allows the Revelation Hip System to meet these requirements by engaging the lateral femoral cortex.

Hip Biomechanics

In 1917, John C. Koch, M.D., of John Hopkins University, defined the traditional model of hip loading. He believed that a downward force applied to the femoral head during unilateral stance would create a compressive load in the medial aspect of the femur and tensile loading in most of the lateral cortex. Koch's work became the standard by which hip biomechanics was analyzed. Due to limitations of its time, it did not, however, include soft tissues, and thus contains several inconsistencies with regard to bone morphology and energy expenditure. The most obvious question concerns the presence of cortical bone in both the lateral and the medial femur. According to Wolff's law, bone is formed in response to the loading it experiences. The tension in the lateral femur as stated by Koch would theoretically result in poorly calcified or uncalcified material in that area. This, of course, does not correspond to femoral features observed in clinical practice.
The Ilio-Tibial Model

In the 1980s, Dr. Fetto’s work with above- and below-the-knee amputees led to discovery of the importance of the ilio-tibial band and its possible implications on hip replacement design. The ilio-tibial model, as presented by Dr. Fetto et al., extends Koch’s model by adding the ilio-tibial band as a lateral tension band. As a result, the lateral femur is shown to be under compression rather than tension during the unilateral stance phase of gait. The lateral femur thus becomes a potential base of support for femoral components.

Proximal Femur Load Transfer

By loading the lateral femur, the Revelation Hip System reproduces normal physiologic loading patterns, reduces potential for subsidence, and avoids diaphyseal overloading, which has been cited as a cause of thigh pain. The point of lateral engagement is at, or proximal to, the intersection of the mid-neck axis and the lateral cortex. The Revelation femoral component provides secure primary stability which is a prerequisite for a long-term biological fixation through bone ongrowth. Compared to a straight stem, the Revelation stem has been shown to be significantly less likely to migrate.

Conclusion

By reducing bone loss, the Revelation hip stem holds great promise for long-term success of total hip arthroplasty, in particular in younger, more active patients.

The Revelation Hip System features press-fit titanium stems designed to reconstruct proximal femoral anatomy and proximally load the femur. The femoral component's lateral flare engages the cortex at the intersection point of the intended femoral neck axis and the lateral femoral cortex. The Revelation Hip System features state-of-the-art instrumentation that is adaptable to any surgical approach.

- Titanium Press-Fit Stem
- Six stems available in both left and right sizes 9, 10.5, 12, 13.5, 15, and 16.5mm
- Proximal circumferential porous coating
- Highly polished in non-porous proximal region
- Highly polished distal stem to prevent bone on-growth
- 130 degree neck angle
- 12 degrees of anteversion with origin at stem center line
- Coronal slot in larger sizes
- Accepts modular CoCr and ceramic femoral heads

<table>
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<td>126mm</td>
</tr>
<tr>
<td>16.5</td>
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Anterior Asymmetry: 4.5mm
Proximal Body Flare (A/P): 3°
Distal Stem Taper Angle: 1.25°
Preoperative Planning

Preoperative templates are provided for determining optimal component size, femoral neck resection level, appropriate neck length and offset (Figure 1). Radiographs should include a full A/P (anterioposterior) view of the pelvis including the proximal one-half of both femurs and an A/P and lateral view of the proximal half of the affected femur.

As with any surgical procedure, proper radiographs are required for accurate templating. Ideally, the A/P radiograph should demonstrate a full profile of the femoral neck. This is usually best obtained by internally rotating the affected limb 15°. Optimally, this should be individualized to each patient’s anatomy. If the femur is not rotated or incorrectly rotated, the neck length and offset could be misjudged preoperatively.

A standard method of templating is used by aligning the center line of the femoral stem to the center of the femoral shaft and moving the template up or down to align the flare of the prosthesis silhouette with the flare of the bone on the medial/lateral endosteal surface (Figure 2).

Note the diaphyseal fill, the neck resection level, and the modular neck length estimation. Careful attention should be made to note the proposed neck resection level by measuring the distance between the templated neck resection level and the superior aspect of the lesser trochanter.

The lateral radiograph should be used for checking diaphyseal fill with the stem size selected on the A/P.
Surgical Approach
The preferred approach is a modified posterior approach with the patient stabilized in a lateral decubitus position. The skin incision is generous in length and directed posteriorly perpendicular to the femoral shaft at the level of the tip of the greater trochanter. This incision enhances access and exposure of the femoral canal when the hip is flexed, adducted, and internally rotated.

Femoral Neck Resection
The femoral neck cut should be made by using the osteotomy guide corresponding to the templated stem size (Figure 3).

The femoral neck resection should be measured proximally from the lesser trochanter based on the preoperatively templated measurement. A cut made too proximal may result in the prosthesis not fully engaging the lateral cortex and resting too "proud" within the femoral canal.

Femoral Preparation
It is critically important that the relationship of the femoral canal and the greater trochanter be appreciated. The starter awl is attached to the T-handle and the canal is opened at the piriformis fossa (Figure 4). Lateralization is important to proper positioning. The box osteotome is utilized to open the superior aspect of the femoral neck in the piriform fossa (Figure 5).
**Femoral Canal Reaming**

**OPTION #1 Straight Reamers**
The reamer helps prepare both the distal and proximal canal. The reamer features a reverse helix cutting design, proximal chip breakers, and a distal bullet tip to ensure axial alignment. Reamers are labeled to correspond to their respective implant size. Each reamer will prepare the femoral canal to accommodate the distal stem taper and prevent distal load transfer (Figure 6a).

The reamer may be attached to power or the manual T-handle (Figure 6b). Hand reaming is recommended due to the aggressive nature of the reamers.

A reamer two sizes below the templated stem should be selected and progress incrementally until reasonable corticocancellous contact is achieved.

It is imperative that the femoral reamer be properly aligned in the medullary canal with special attention to avoid varus and/or flexion misalignment. The reamer should be inserted until the proximal groove aligns with the level of the osteotomy (Figure 7).

Failure of the reamer to pass smoothly through the femoral canal might be caused by a misalignment of the reamer relative to the axis of the femoral canal. This is corrected by more valgus (lateral) and/or extended (posterior) directed placement of the reamer in the metaphyseal portion of the femur. Do not ream beyond the size of the anticipated implant size determined by preoperative templating.
OPTION #2 Flexible Reamers

Femoral canal reaming may also be performed with flexible reamers. A ball-tipped guide wire is passed down the medullary canal. A modular reamer head at least 2mm smaller than the size indicated by the preoperative templates should be selected. The canal is reamed over the guide wire with reamers of increasing diameters until a uniform diaphyseal diameter equal to the selected hip stem size is created.

It is imperative that there be no loading of the femoral diaphysis due to tight fixation of the distal one-third of the implant stem within the femoral medullary canal.

Broaching

Revelation Hip lateral-flare broaches are exactly matched to the dimensions of the corresponding porous coated implant. A broach at least one to two sizes smaller than the anticipated implant stem should be used initially.

It is imperative that the femoral broach be properly aligned in the medullary canal with special attention to avoid varus and/or flexion misalignment (Figure 8). Inability to fully seat a femoral broach might be caused by misalignment of the broach relative to the axis of the femoral canal. This is corrected by more valgus (lateral) and/or extended (posterior) placement of the broach in the metaphyseal portion of the femur.

An optional modular slaphammer is available for broach impaction or extraction (Figure 9).

In surgeries involving removal of fixation hardware or compromised femoral bone, it is strongly advised that prophylactic wiring prior to broaching be employed in anticipation of possible intraoperative fracture of the femur.

After initial broaching, the proximal lateral aspect of the medullary canal should be visually inspected. To avoid lateral compaction, it may be necessary to further remove the lateral cancellous bone with a medium sized curette (Figure 10). This will facilitate broaching and proper seating of the final lateral-flare broach which will remain in place as a provisional component for trial reduction of the hip.
Removal of the broach and examination of the surface of the medullary canal should confirm correct seating of the lateral flare broach. Correct positioning will demonstrate broach tooth marks around the perimeter within the medullary canal. Particular attention should be given to observing the presence of these markings on the lateral surface of the femur in the region of the greater trochanter flare. An alternate method of assessing correct seating of the lateral-flare broach is by the use of intraoperative radiographs. A trial reduction can be performed with the broach, corresponding head/neck adapter and modular femoral head trial to insure adequate/optimal joint stability (Figure 11).

**Implant Seating**

After confirmation of restoration of alignment, stability, and uninhibited range of motion, the broach is removed. It is replaced by the definitive femoral component. The femoral component is GENTLY SEATED into its final position (Figure 12). Knowing that the femoral component and final broach are identical in geometry gives the operating surgeon confidence in achieving accurate final seating and placement of the component.
Final Head Section

Once the stem has been fully seated, a trial head is fitted to the prosthesis (Figure 13). The hip is reduced, leg length is checked, and range of motion is confirmed before final head size and neck length are selected (Figure 14).

Closure

The joint is inspected for any osteophytes or debris that could have access to the articulating surface. The hip is reduced and closure initiated while giving careful attention to an anatomic reconstruction of the capsular and muscular tissues of the hip, so as to improve joint stability during postoperative activity.

Postoperative Rehabilitation

The patients, unless constrained by bone defects, are permitted full weight bearing as tolerated. Range-of-motion restrictions are only in flexion (0-90 degrees), adduction (0 degrees), and internal rotation (0 degrees) during the initial six weeks post-surgery, so as not to compromise soft-tissue healing. Stationary bicycle and light progressive resisted exercise is begun as tolerated, usually by three to four weeks post-surgery. Stimulation of the proximal femur is a specific intention of the design concept. Therefore, moderate activity consistent with the material limitations of the prosthesis component parts is to be encouraged.