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The removal of extensively porous-coated femoral stems

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ABSTRACT

Cementless total hip arthroplasty (THA) is the favored fixation for primary THA in the United States. While cylindrical extensively porous-coated femoral stems have demonstrated long-term survivability, the distal ingrowth can create challenges in cases where these stems need to be extracted. This technique article outlines the current methods for extracting extensively porous-coated stems. Traditionally, the extended trochanteric osteotomy (ETO) has been used; however, we present a technique that eliminates the need for osteotomy fixation hardware, eliminates the risk of fragment migration, and nonunion while not compromising the surgeons ability to convert to an ETO if necessary.

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1. Introduction

Cementless total hip arthroplasty (THA) is currently the favored fixation method for primary THA in the United States, providing durable long-term biologic stability [1]. Cylindrical extensively porous-coated (EPC) cementless femoral stems were popularized in the 1980s. The EPC cylindrical femoral stem was one of the first successful porous-coated implants with survivability of 98% demonstrated at 20 years [2]. While these stems provide excellent diaphyseal cortical fixation, access to the bone–implant interface can prove difficult in revision scenarios and may require the utilization of advanced reconstructive techniques. This article aims to review the methods for removal of extensively porous-coated femoral stems with a closer look at the senior author's preferred method of extraction.

2. Indications

The indications for removal of a porous-coated femoral stem are similar to a cemented stem; and include infection, aseptic loosening, breakage, component malposition, instability, pain, periprosthetic fracture, femoral osteolysis, inadequate exposure during acetabular revision, and failure or damage to modular connections [3]. Among these, infection, loosening, and breakage are by far the most common reasons to remove an EPC. Occasionally, in the setting of a loose stem, simple manual extraction is all that is required. However, in EPC

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stems that achieve ingrowth, more advanced extraction methods are generally required.

2.1. *Clinical and radiographic assessment*

Prior to proceeding to the operating room for explantation of an EPC femoral stem, a thorough pre-operative clinical and radiograph assessment is necessary. In the evaluation of painful hip arthroplasties, infection must always be suspected and ruled out with ancillary studies, including routine inflammatory labs, serial radiographs, and aspiration. Persistent thigh pain can occur with loose, as well as with bone ingrown implants [4]. Differentiation of this diagnosis requires review of serial radiographs because the procedure for removal of a bone ingrown painful stem is more complex than removal of a loose stem. Radiographic examination should include standard anteroposterior (AP) and lateral views of the hip and femur as well as an AP of the pelvis. Radiographs must be scrutinized for evidence of stem stability or lack thereof (Table). Classic signs of bone ingrowth in EPC stems include spot welds, proximal bone resorption secondary to stress shielding, and calcar rounding [5]. It is often difficult to identify a loose stem based on radiographs alone. The clinical exam and history are important. Patients with a loose stem typically have a "start-up" limb, whereas thigh pain associated with bone ingrowth typically becomes symptomatic after walking a distance [4].

Details regarding the specifics about the implant are determined from previous operative reports, corroboration with sales representatives or surgeon familiarity with the implant system. The stem diameter and length are the most important characteristics. The location of the transition zone to the cylindrical portion must be determined to remove an ingrown EPC. Stems longer than 6 in. may be bowed, making extraction more difficult. The presence of a large proximal collar can inhibit access to medial bone, forcing the use of an extended trochanteric osteotomy (ETO).

Table – Radiographic Features of Implant Fixation

Stable Fixation	Unstable Fixation
Bone ingrown	
No subsidence	Progressive subsidence
Spot weld formation	Varus or valgus shift
Proximal stress shielding	Divergent sclerotic lines
No sclerotic lines	Canal widening—not apparent on immediate post-operative films
Calcar rounding/atrophy	Halo pedestal[a]
Shelf pedestal[b]	Calcar hypertrophy
Fibrous encapsulation	
No subsidence—or subsidence that stabilizes within 1 year	
Parallel sclerotic lines	
Minimal proximal bony atrophy	

[a] Halo pedestal is defined as new endosteal bone formation associated with radiolucencies and/or sclerotic lines around the stem tip, indicative of micromotion.

[b] Shelf pedestal is defined as new endosteal bone formation at the stem tip that is in direct contact with the stem.

2.2. *Exposure*

The standard posterior approach is preferred as it is extensile and allows for safe proximal and distal extension, providing excellent visualization of the femur. In the setting of revision procedures, wide exposure is critical in order to achieve free mobility of the proximal femur to safely dislocate and extract components, while minimizing fracture risk. Regardless of the extraction technique planned, it is critical to evaluate the medial aspect of the greater trochanter with respect to the implant. Even the slightest amount bone overhanging the medullary canal will place the greater trochanter at undue risk of fracture during implant removal. This can be accomplished by clearing fibrous tissue and bone from the medial face of the greater trochanter with high-speed burrs. The shoulder of the stem must be completely clear of all tissue and bone prior to any attempt at implant extraction.

2.3. *Instrumentation*

Instruments necessary for a successful explant include thin flexible osteotomes of varying sizes for metaphyseal bone–implant division; a high-speed small-tipped burr and several appropriately sized hollow trephines. Carbide cutting bits allow for metal-cutting capabilities, which are required for collar removal, stem transection, and notching of the neck. Power oscillating sagittal saws should be available if an osteotomy is planned.

Extraction tools that help remove the component from the canal include modular head and neck detachment devices as well as femoral stem extractors. The authors' prefer the universal stem extractor that consists of a rectangular bar that fits over the neck through an oval opening with a set screw laterally, that when tightened, drives the opening in the rectangle bar into the medial neck. Additionally, long-handled bone punches may be needed to aide in stem dislodgement during the final steps of component removal.

2.4. *Techniques for implant extraction*

Following adequate surgical exposure, dislocation, head-ball removal, and clearing of all tissue from the proximal aspect of the implant, an intra-operative assessment of implant stability is tested. Either an implant-specific extractor or universal extractor may be used. Ensuring maximum metal-to-metal contact on the extractor–implant interface, as well as the slap hammer or strike plate will allow for the greatest force to be imparted on the bone–implant interface allowing for a true assessment of stability. For implants with no step-off between the machined aspect of the trunion and the base of the neck, or when the extractor loses grip on the trunion, a small notch can be cut with the carbide bits for improved purchase (Fig. 1). Stems exhibiting signs of motion are deemed unstable and manual extraction is continued until the stem is removed. However, if after several blows with the extraction device, no motion is visualized, the stem is then considered stable. It is recommended that further attempts of forced manual extraction should be abandoned as continued blows may risk iatrogenic femoral fracture. Subsequent removal methods are aimed at dividing the