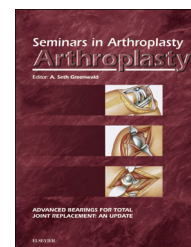


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Classifying femoral bone deficiency: Picking the right tool for the job



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ABSTRACT

The number of total hip arthroplasties continues to increase each year, and with it grows the demand for surgeons prepared to manage complicated revisions. To date, the Paprosky classification system is the most commonly used, well described, and successfully implemented classification system for periprosthetic femoral bone loss. In this review, the Paprosky femoral bone loss classification is presented in detail, using illustrative examples of cases encountered by the contributing authors.

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1. Introduction

It is projected that the number of procedures for all total joint arthroplasties, including revision procedures, will continue to rise steadily into the next decade in the U.S., thereby increasing the demand for well-prepared surgeons to manage potentially complicated reconstructions for the hip and knee [1]. Revision total hip arthroplasty (THA) requires an understanding of both simple and complex strategies to address a spectrum of conditions that may complicate hip replacement, including the management of periprosthetic bone loss. Multiple classification systems have been developed to describe bone loss surrounding THA, generally separated by evaluating the acetabular side independently of the femoral side [2–5]. Ideally a classification system will characterize bone loss in such a way that enables the evaluating surgeon to plan future treatment predictive of reliable long-term clinical outcomes. In such a system, the surgeon can perform optimal preoperative planning and templating, request all appropriate equipment needed for surgical treatment, and avoid unanticipated intraoperative findings. For these reasons, the most commonly used, well-described, and successfully

implemented classifications for periprosthetic bone loss are the Paprosky femoral and acetabular bone loss classifications [3,4].

Focusing on the femoral side, the Paprosky femoral bone loss classification may be used to describe the location of proximal femoral bone loss, characterize the degree of remaining supportive bone, and imply reconstructive options [6]. Radiographic evaluation for this classification system is performed using plain radiographs to include an AP view of the pelvis, and AP and lateral views of the hip. These films must be of sufficient length to evaluate the integrity of the femoral diaphysis to include the isthmus where component fixation may be required [2]. In this review, the Paprosky femoral bone loss classification is presented in detail using illustrative examples. Major features of the Paprosky femoral bone loss classification are also summarized in Table.

1.1. Type I femoral bone loss

A femur with a type I defect may be characterized by minimal proximal bone loss. The metaphysis is supportive with intact cancellous bone (which allows for the use of cement if

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Table – Summary of the Paprosky Femoral Bone Loss Classification

Type	Metphysis	Diaphysis	Notes
I	<i>Intact</i>	<i>Intact</i>	Cancellous bone is preserved, may be treated as a primary THA with either cemented or cementless fixation
II	<i>Supportive</i>	<i>Intact</i>	Metaphysis is supportive, and a stem that gains primary fixation in the metaphysis may be used; may not be amenable to cemented fixation given the loss of cancellous bone proximally unless a long cemented stem is utilized
III	<i>Non-Supportive</i>	<i>Supportive</i>	Requires primary fixation in the intact diaphysis
IIIA		<i>> 4 cm Isthmus</i>	Usually reconstructed with fully porous-coated stem if diameter < 18 mm
IIIB		<i>< 4 cm Isthmus</i>	Typically reconstructed with modular tapered femoral component
IV	<i>Non-supportive</i>	<i>Non-supportive</i>	Most difficult to manage as no isthmus present for distal fixation; may be amenable to impaction grafting or require proximal femoral replacement. Success may also be achieved using modular tapered stems if “three-point” fixation is achieved.

desired) and the diaphysis is fully intact. Examples of this type of defect are seen with failed hip resurfacing procedures requiring revision to THA (Fig. 1) or when revising a cementless femoral component without biologic osseointegration surface (e.g., Austin Moore prosthesis). Reconstructive options for revision of a type I defect are straightforward for the surgeon familiar with primary THA and include the multitude of cemented or cementless implants used in primary THA. If cemented implants are used, it is advised that great care is taken to remove any fibrous membrane that may be present to allow for an adequate cement mantle [7].

1.2. Type II femoral bone loss

A type II femoral defect is characterized by significant loss of cancellous bone in the metaphysis, however, it is supportive and can be relied upon for primary fixation of the revision

stem with a primary type implant if desired; the diaphysis is intact. This type of defect may be seen with removal of a cemented femoral component, if considerable metaphyseal bone loss takes place during the removal of a well-fixed, proximally-coated femoral component, or when primary femoral component loosening and subsidence takes place resulting in metaphyseal bone loss (Fig. 2). Options for reconstructing a type II defect include the use of a cementless stem that gains primary fixation in the metaphysis or the use of a stem that relies primarily on distal fixation. Distal fixation is commonly our preference, as in many cases it can be difficult to determine intraoperative if the metaphysis is truly supportive. If distal fixation is selected, our preference is to use the shortest diaphyseal engaging stem that will contact 4 cm of intact isthmus bone. Hence, the stem does not necessarily have to be “long.” Excellent results have been reported using this option, with stable long-term fixation and

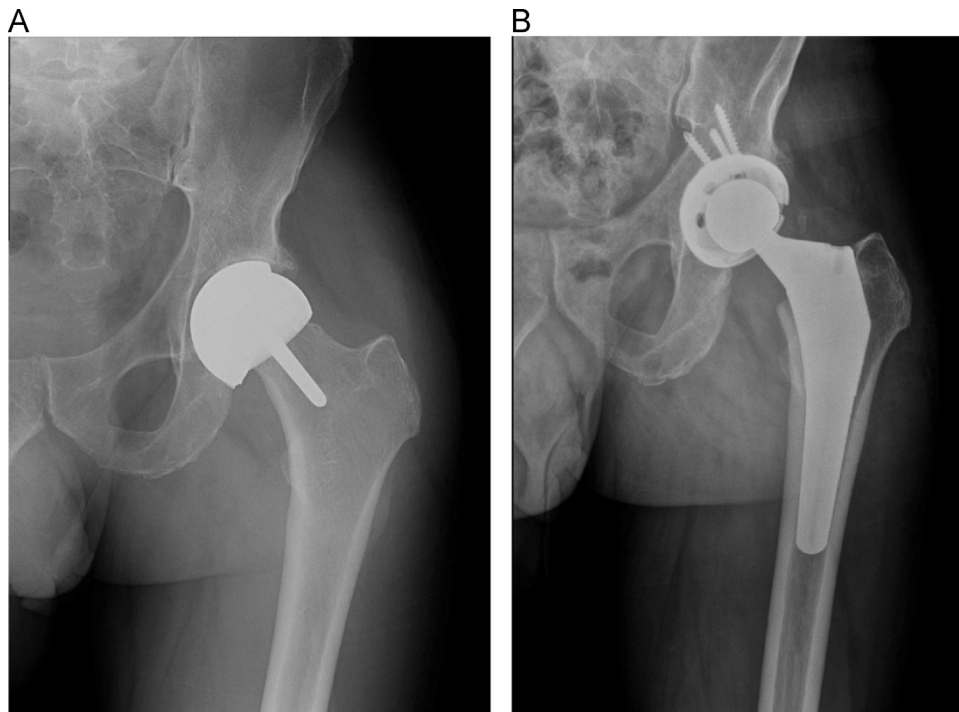


Figure 1 – Paprosky type I femoral bone loss. (A) Preoperative x-ray of a type 1 femur in a patient with a failed resurfacing. Note the high inclination angle of the cup that led to an adverse local tissue reaction. (B) Postoperative x-rays showing reconstruction using a primary cementless femoral component.

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