Extra-Articular Deformities and the Role of Hip Resurfacing
A Proposed Classification System

Steven A. Stuchin, M.D.

Abstract
There has been an increasing demand for hip resurfacing as an alternative to total hip arthroplasty. A number of reports have been published recently detailing the technique and role of resurfacing in a variety of extra-articular deformities, dysplastic conditions, and settings of retained intramedullary hardware and other impediments. The following report proposes a classification system that recognizes intramedullary and extramedullary deformities. With the long-term expectation for resurfacing, these complex situations may require categorization to segregate risk factors in order to allow for better planning and prognostication.

The increasing desire for high performance total hip arthroplasty in young patients has led to a rising demand for hip resurfacing. The indications and limitations of this technology in a variety of anatomic, biological, and metabolic conditions remain an open question. Recently, there have been a few reports detailing the use of resurfacing in a variety of extra-articular deformities, dysplastic conditions, and intramedullary impediments.1-4 The number of patients reported undergoing hip resurfacing with deformities that might constitute a surgical challenge is small. However, it is anticipated that this number will grow appreciably. The variety of challenges these conditions present is such that evaluating them as one category offers no meaningful scientific conclusions. Accordingly, a classification system that identifies and respects the differences among these deformities may be useful to segregate risk factors in order to allow for better planning and prognostication. The proposed classification system recognizes intramedullary and extramedullary deformities, and combined deformities, a third category. Intramedullary categories include expanded, constricted, and obstructed. Constriction or obstruction may be caused by bone or an implant. Extramedullary deformities include the variety of femoral shaft problems: angular, rotatory, translational, and longitudinal, i.e., leg-length discrepancy. Complex deformities, such as developmental dysplasia of the hip, may draw on both intramedullary and extramedullary elements or may be combined.

The canal-sparing strategy of hip resurfacing has led investigators to suggest its utility in anatomic situations that might challenge a conventional total hip arthroplasty stem.1 There is a paucity of scientific literature on this specific subject, but there are a few studies reporting the use of resurfacing in conditions that certainly qualify as extra-articular deformity. Mont and colleagues list extra-articular deformities within their study, including femoral bowing or other deformities that could not support a standard femoral stem, intra- or transmedullary hardware that would block the stem of a standard total hip femoral component, and bone grafts that might impede canal preparation.2 They reported on 17 resurfacing arthroplasties performed in patients with femoral deformities caused by trauma, renal osteodystrophy, proximal femoral focal deficiency, multiple epiphyseal dysplasia, and retained hardware. One hip required two subsequent revisions. The other 16 hips were described as doing well, with a mean Harris hip score of 92 points (range, 81 to 100 points). The investigators concluded that resurfacing was an attractive and straightforward procedure for patients with extra-articular deformity.

The results of resurfacing in developmental hip dysplasia also have recently been published. McMinn and coworkers reported on 110 resurfacings in patients with dysplasia. Nine
required subtrochanteric osteotomies for femoral anteversion of greater than 45°. The survival rate was 95.2%, with three failures for femoral neck fracture, sepsis, and femoral head collapse, respectively.³ McBryde and associates described 96 dysplastic hips treated with resurfacing. Three required subtrochanteric osteotomy. Their 5-year survival rate was 96.7%. Four acetabular fixation failures and one femoral neck fracture occurred.⁴

Older reports of total hip surgery for both difficult and dysplastic hips cite a significant nonunion and failure rate.⁵,⁶ Papagelopoulos and colleagues reported on 20 primary and 11 revision hips that required femoral osteotomy as part of the reconstruction. Diagnoses of the femoral deformities in the primary hips included failed osteotomies, hip dysplasia, congenital bowing, subtrochanteric fracture malunion, fibrous dysplasia, slipped epiphyseal dysplasia, and Paget’s disease. The investigators listed 75% fair or poor results and only 25% good or excellent results. In addition, they had a 30% reoperation rate. Yasgur and coworkers studied nine hips with developmental dysplasia of the hip that were treated with a total hip arthroplasty and a subtrochanteric shortening osteotomy. While they noted 85% good to excellent results, there were two nonunions. One was asymptomatic, but the other included an implant fatigue fracture in a distally fixed femoral component.⁶

Recent studies of total hip arthroplasty in difficult and dysplastic hips show better results. Biant and associates reported on 55 primary total hips that they considered anatomically difficult. The diagnoses included developmental dysplasia of the hip, Paget’s disease, posttraumatic injury and osteoarthritis with anatomic abnormalities, Perthes disease, proximal and distal femoral mismatch, childhood hip sepsis, slipped epiphysis, coxa magna, prior hip fusion, protrusio, and osteonecrosis. At a 10-year follow-up, the mean Harris hip score was 85 points, with no osteotomy nonunions.⁷

The variety of surgical challenges these various anatomic conditions present is such that evaluating them as one category offers no meaningful scientific conclusions. Accordingly, a classification system that identifies and respects the differences among these deformities may be useful. The proposed classification system recognizes intramedullary and extramedullary deformities. Intramedullary categories

**Table 1 Extra-Articular Deformity Classification**

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<thead>
<tr>
<th>Intramedullary</th>
<th>Expanded</th>
<th>Constricted</th>
<th>Bone</th>
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Extramedullary

- Angular
- Rotatory
- Translational
- Longitudinal
- Combined

**Figure 1** This preoperative radiograph (A) demonstrates a complex extra-articular femoral deformity. There are both intra- and extramedullary elements. The intramedullary canal is expanded. The prior fracture healed with elements of angulation, rotation, and translation. Postoperative radiograph (B) following hip resurfacing, which allowed for a procedure that did not require contending with these factors.
include expanded, constricted, and obstructed. Constriction or obstruction may be caused by bone or retained implant.

Extramedullary deformities include the variety of femoral shaft problems: angular, rotatory, translational, and longitudinal, i.e., leg-length discrepancy. Combined deformities, such as developmental dysplasia of the hip or patients with a history of complicated femoral fractures, draw on several classification elements (Table 1). Standardizing the vocabulary for femoral problems should lead to clearer communication and a better understanding of treatment and prognosis (Fig 1).

To date, only a small number of patients are reported to have undergone hip resurfacing with the aforementioned deformities that represent a surgical challenge. This unique population, however, is expected to increase appreciably in size in the future. Given the long-term expectations for resurfacing, these more complicated situations demand categorization that will segregate risk factors to allow for better planning and prognostication.

**Disclosure Statement**

The author has no financial or proprietary interest in the subject matter or materials discussed, including, but not limited to, employment, consultancies, stock ownership, honoraria, and paid expert testimony.

**References**