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Prophylactic Fixation of the Femoral Neck after Hip Resurfacing Arthroplasty

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Abstract. Technical error during hip resurfacing arthroplasty can compromise the structural integrity of the femoral neck and place the patient at increased risk for fracture. Hip resurfacing arthroplasty is a challenging procedure, and as more inexperienced surgeons attempt to perform it, the incidence of this potentially disastrous complication will increase. Salvage of the arthroplasty after fracture is very difficult. We propose a simple technique of prophylactic internal fixation of the femoral neck with parallel pins in cases in which the surgeon recognizes an intraoperative technical error that predisposes the patient to fracture.

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1. Background

Hip resurfacing arthroplasty has re-emerged as an effective treatment option for arthritis in young, active individuals with good bone density. Improved metallurgy and manufacturing techniques have led to the development of third-generation devices with metal-on-metal bearings and cementless acetabular fixation. While these improvements have eliminated earlier problems, such as polyethylene wear-induced osteolysis and acetabular cup loosening, femoral neck fracture remains the leading cause of early implant failure [1-5].

2. Hypothesis

We hypothesize that prophylactic fixation of the femoral neck can reduce the risk of fracture after hip resurfacing arthroplasty and treatment of FAI (FIG 1). While we do not advocate applying this strategy to all patients, those with an increased risk of fracture secondary to surgeon technical error during the primary procedure may benefit from this preventive measure.

3. Femoral Neck Fracture after Hip Resurfacing Arthroplasty

Femoral neck fracture after hip resurfacing ranges from 0 to 4% in recent large series, with the majority occurring within 110 days after surgery [1-4, 6-9]. Hip resurfacing is a more challenging procedure than total hip replacement because it requires exposure of the acetabulum without resection of the femoral head and neck [10, 11]. There is a significant learning curve and most studies have found that the rate of femoral neck fracture is inversely related to the experience of the surgeon [2, 6-7]. In a study of 55 retrieved implants from multiple surgeons, the time to revision was directly related to the number of prior procedures performed; 20% of failures occurred in the

surgeon's first ten procedures performed.⁷ Marker reported that 12 of 14 fractures occurred in the first 69 procedures performed.³ Many of the major risk factors for fracture, such as intraoperative notching, excessive varus placement (<130° neck-shaft angle), removal of structurally important anterior osteophytes, and failure to cover all of the reamed trabecular bone are technical errors.

Hing et al. found that 18.7% of 230 cases had evidence of notching [9] and Pollard *et al.* reported uncovered reamed bone in 19% of 54 hip resurfacings [4]. In a review of 3497 hip resurfacings, notching of the superior femoral neck and varus placement of >5° compared with pre-operative neck-shaft angle was seen in 46.6% and 71.1%, respectively, of patients who subsequently fractured [2]. Specimens in 10° varus have been shown to be significantly weaker than neutrally aligned specimens [12]. In a prospective study by Marker, intraoperative notching occurred in five of 14 patients who sustained femoral neck fractures [3]. In a series of 600 cases, failure to cover all of the reamed bone with the femoral component contributed to three of five fractures [1].

It is well known that varus placement of the femoral component increases tensile stress on the superior cortex, compressive stress on the medial aspect and shear stress at the prosthesis-neck junction [8, 13-14]. Ten degrees of varus alignment increases strain on the superior aspect of the neck by 19% to 23% and notching decreases neck strength by 21% [15]. Injudicious removal of load-bearing bridging osteophytes [1, 6, 16]. or leaving the implant proud and failing to cover fresh circumferentially reamed trabecular bone can cause significant stress-risers.¹ In patients with pre-existing cam-type hip impingement, removal of 20% of the head-neck junction diameter is required to allow hip flexion, but as little as 30% resection can significantly reduce the load to failure [17]. In an average patient, this 10% margin for error is only 5 mm.

Postoperatively, patients are typically



Figure 1. Anteroposterior radiograph of a hip resurfacing implant with proposed prophylactic pins across the femoral neck.

allowed protected weight bearing with crutches for three to six weeks. High-impact activities are restricted for six months to one year to allow the femoral neck to remodel. The literature supports a period of extended non-weightbearing, protected weightbearing, or even intraoperative conversion to THR, if the surgeon is aware of technical complications that predispose to femoral neck fractures [2-3, 11, 13, 18-19]. Nevertheless, a conservative convalescent weight-bearing protocol does not appear to prevent fracture in patients with notched femoral necks [6]. Internal fixation of a displaced femoral neck fracture after hip resurfacing arthroplasty is a difficult procedure with mixed results [2, 20-22].

4. Rationale for Prophylactic Fixation

We propose that prophylactic internal fixation of the femoral neck can reduce the risk of fracture in cases which the surgeon intraoperatively recognizes a technical error. Parallel pins are routinely used during treatment of non-displaced femoral neck fractures and tension-side stress fractures. It is a relatively easy technique and can bail out inexperienced surgeons during hip resurfacing arthroplasty. Exposure of the femoral head during machining of the proximal femur allows for retrograde placement of the parallel pins. Functioning similar to a reinforcing bar (“rebar”), the pins would increase the load to failure of the

proximal femur. Similar to industrial construction, concrete and bone are both very strong in compression, but would benefit from metal rebar to resist tension. To the knowledge of these authors, this technical concept has not previously been reported.

5. Conclusion

Hip resurfacing arthroplasty has emerged as a popular, bone-conserving alternative to total hip arthroplasty in younger, more active patients. Femoral neck fracture is the most frequent major complication after this procedure and is often associated with known surgical errors. Prophylactic internal fixation may help reduce the incidence of fracture most notably during the initial steep learning curve of hip resurfacing arthroplasty.

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Conflict of interest statement: The authors have nothing to declare.