

Postresurfacing Periprosthetic Femoral Neck Fractures: Nonoperative Treatment

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abstract

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Femoral neck fractures after total hip resurfacing procedures occur infrequently but require immediate orthopedic intervention. Historically, they have been treated by conversion to traditional total hip arthroplasty. However, to the authors' knowledge, no treatment algorithm has ever been described. The authors have directly treated or consulted on 13 cases of periprosthetic femoral neck fractures after metal-on-metal hip resurfacing arthroplasties that were successfully treated nonoperatively: all fractures healed with protected weight bearing, producing excellent clinical results. Two cases are described in detail, and the authors propose a classification system that can assist the orthopedist in choosing the treatment regimen. Type I fractures are nondisplaced and should be initially treated nonoperatively with a course of protected weight bearing. If successful, the overall success of the resurfacing should not be compromised. Partially displaced, or type II, fractures may heal with nonoperative management. However, if the components have shifted, it may affect the long-term durability of the arthroplasty and eventually result in premature conversion to a traditional total hip replacement. Depending on the position of the components, it may also have an effect on the ion generation potential of the metal-on-metal articulation. This treatment pathway can be undertaken only with a full and detailed explanation of all of the possible complications and outcomes with the patient. Completely displaced, or type III, fractures require immediate conversion to total hip arthroplasty.

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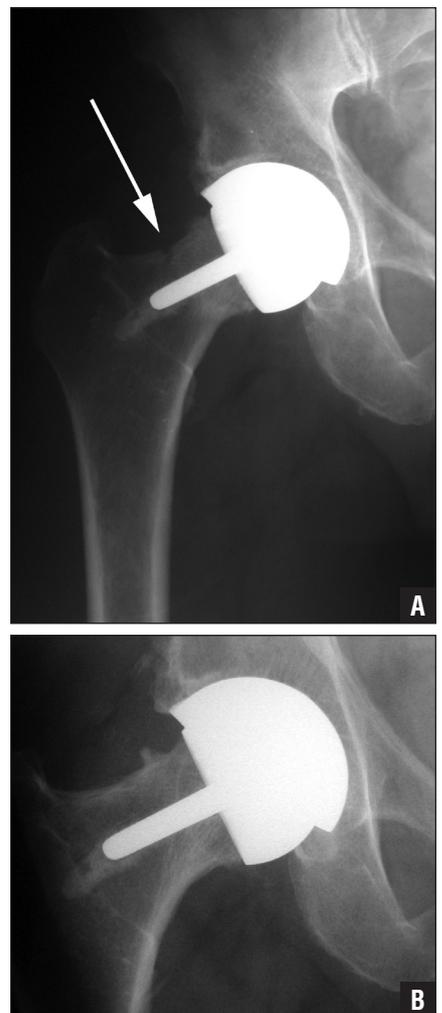


Figure: Conventional anteroposterior radiographs of a nondisplaced periprosthetic femoral neck fracture after a right hip resurfacing arthroplasty 10 weeks after surgery showing the fracture (A) and 52 months after surgery showing stable components (B).

As more data have been collected on metal-on-metal devices, the indications for hip resurfacing have decreased. However, the bone-sparing nature of the procedure makes it a potential option for younger, active patients, particularly men.¹⁻⁹ Femoral neck fracture after hip resurfacing is an uncommon complication associated with hip resurfacing that does not occur in traditional total hip arthroplasties (THAs). Most reported cases were treated with revision surgery and conversion to THA.^{1,10} This article describes 2 femoral neck fractures after hip resurfacing that were successfully treated nonoperatively and 11 other summarized femoral neck fractures, as well as a new classification scheme that may help guide treatment for this complication.

CASE REPORTS

Patient 1

A 64-year-old man presented with severe right hip pain with all activities. Ambulation was restricted to 2 to 3 blocks, and activities of daily living were seriously limited. Previously, the patient had been an active tennis player. Nonoperative treatment had failed, and the patient met the requirements for THA. He had researched hip resurfacing before presentation and was well informed about the bone-sparing nature of the procedure and its investigational status with the Food and Drug Administration. He asked to be a candidate for hip resurfacing because he desired to return to his previous activity level and because he considered himself to be biologically younger than his 64 years.

Preoperative range of motion (ROM) was 80° of flexion, 10° of internal rotation, and 15° of external rotation, and radiographs showed bone-on-bone arthritis. For the hip resurfacing procedure, an anterolateral approach was used to implant a Cormet 2000 (Corin Medical, Ltd, Cirencester, United Kingdom) metal-on-metal hip resurfacing device. No troughs for cement extravasation were placed under the femoral component because this

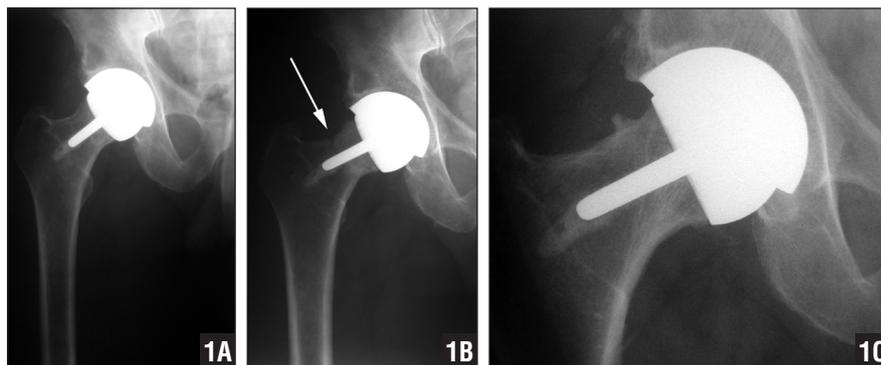


Figure 1: Conventional anteroposterior radiographs of a patient who had a nondisplaced periprosthetic femoral neck fracture after a right hip resurfacing arthroplasty at 6-week follow-up (A), 10 weeks after surgery showing the fracture (B), and 52 months after surgery showing stable components (C).

procedure was not yet a part of the authors' standard technique. An uncemented 56-mm acetabulum and a No. 6, forty-eight-mm cemented femoral cap (Corin Medical, Ltd) were inserted via standard instrumentation without difficulty.

The patient was discharged 3 days after surgery and was kept at 20% weight bearing, which was the standard rehabilitation protocol. At 6-week follow-up, the patient reported no pain and advanced to weight bearing as tolerated. Radiographs showed that the components were in good position, with no evidence of fracture (Figure 1A). Approximately 10 weeks after surgery, the patient reported right hip pain while raking leaves. Radiographs showed a nondisplaced femoral neck fracture with a crack in the superior cortex (Figure 1B). The patient was instructed to be nonweight bearing with crutches for 2 months, after which he progressed to 50% weight bearing for 6 weeks. Sequential radiographs showed the fracture healing with minimal displacement at 22 months. He was then followed up annually, and he was asymptomatic and had returned to playing tennis at last follow-up (52 months after surgery) (Figure 1C). Range of motion was 100° of flexion, 15° of internal rotation, 30° of external rotation, and 50° of abduction, and no leg-length discrepancy existed. In addition, he had an excellent result according to the Short Musculoskeletal Function Assessment.¹¹

Patient 2

A 53-year-old woman presented with right hip pain, markedly restricted activities of daily living, and ambulation limited to 2 to 3 blocks. Range of motion was flexion to 80°, no internal rotation, and external rotation to 10°. Radiographs showed bone-on-bone arthritis. Nonoperative treatment had failed, and she met the THA criteria. She had researched hip resurfacing before presentation and requested the procedure. She met the requirements for hip resurfacing and understood the risks and benefits. She also read and signed the Food and Drug Administration operative consent form.

A metal-on-metal hip resurfacing was performed through an anterolateral approach. No cement extravasation troughs were placed under the femoral cap because this procedure was not yet part of our standard technique. A Cormet 2000 50-mm cementless acetabular component and a No. 4 forty-four-mm cemented femoral cap (Corin Medical, Ltd) were implanted via standard instrumentation. The patient was discharged 3 days after surgery and was restricted to 20% weight bearing, the standard postoperative protocol at that time.

At 6-week follow-up, the patient was asymptomatic, and radiographs showed excellent position of the components (Figure 2A). However, in retrospect, some cancellous bone was showing on the lateral aspect of the femoral neck, which

could have resulted from excessive cement trapped under the femoral cap, causing the component to not be fully seated. As reported by Amstutz et al,¹ this situation could have contributed to subsequent fracture at the component base.

The patient advanced to weight bearing as tolerated. She reported mild pain around the iliotibial band insertion at the knee but no hip pain at 3-month follow-up. Radiographs revealed a periprosthetic femoral neck fracture with varus angulation. The patient reported no interval history of trauma or hip pain. The decision to treat her nonoperatively was based on a comprehensive discussion with the patient of the potential risks and benefits of nonoperative and operative treatment. She was apprised of the situation in her hip and informed that premature arthroplasty failure was likely because of the position of the femoral component, which could result in a hip fracture that would require immediate surgery. She was also told that she was approximately 1 cm short on the operative side. She was not cognizant of the leg-length discrepancy and elected not to use a shoe lift. The surgical option would have been to convert to a conventional THA. The patient was happy with her result and did not want to undergo an immediate THA.

The patient returned to limited weight bearing and crutches for 2 months. At that time, the patient was asymptomatic and walked with no limp. Radiographs showed the fracture to have healed with no substantial varus angulation increase. The patient advanced to full weight bearing with restricted activities. At 11 months after surgery, she was asymptomatic and was involved in low-impact aerobics. At 23-month follow-up, she was asymptomatic, and the range of motion was flexion to 100°, internal rotation to 10°, external rotation to 25°, and abduction to 60°. She had a 1-cm leg-length discrepancy but no crepitation with hip motion. Radiographs showed increased varus shift of the component,

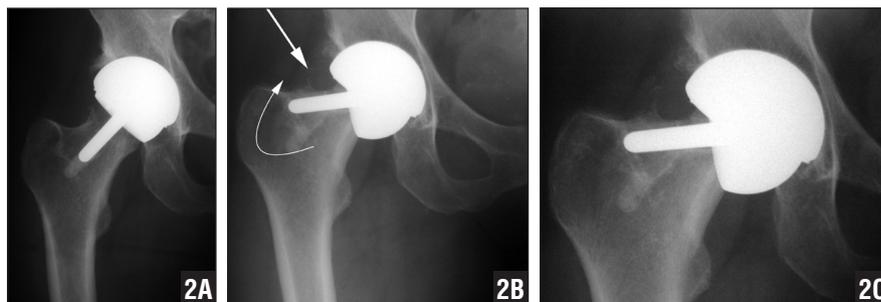


Figure 2: Conventional anteroposterior radiographs at 6-week follow-up (A), 23 months after surgery showing fracture union and no marked deformity progression (B), and 48 months after surgery showing no substantial change (C). The appearance of the bone at the base of the femoral component suggests that it may not have been fully seated, possibly riding high on an excessive cement mantle.

with a subtle change in the overall femoral neck angulation, and remodeling of the superior cortex (Figure 2B). Radiographs 48 months after surgery were stable (Figure 2C).

According to the Short Musculoskeletal Function Assessment,¹¹ her results were excellent: she had marked “a little of the time/a little bothered” on 3 of the 46 questions (“How often do you walk with a limp?” “How often do you avoid using your painful limb?” and “How often does doing too much one day affect what you do the next day?”). The nonoperative treatment can be called successful because the patient continues to enjoy a normal quality of life and is happy with her result. She does not perceive that she has a leg-length discrepancy. She is aware that she is likely to have her hip revised in the future based on the malunion of her fracture and the position of the femoral component.

Other Cases

Of the remaining 11 cases, 4 of the index procedures were performed by 1 of the senior authors (M.A.J.), and 7 were referred to 1 of the senior authors (M.A.J.) for evaluation and or treatment. Eight fractures were nondisplaced or minimally displaced and had healed successfully by 12 weeks after 6 to 8 weeks of nonweight bearing and 6 weeks of nonweight bearing or partial weight bearing. The remaining 3 fractures healed in varus.

DISCUSSION

Femoral neck fractures are uncommon after metal-on-metal hip resurfacing arthroplasty. Several recent large studies (235-3497 hips) have indicated that the prevalence of this complication ranges from 0% to 1.7%.^{3,4,6} In those studies, almost all femoral neck fractures after hip resurfacing were treated with conversion to THA.

Cumming and Fordyce¹² were the first to report the nonoperative treatment of a femoral neck fracture after metal-on-metal resurfacing arthroplasty. Surgical revision was planned after an acute fracture led to moderate varus angulation 2 weeks after surgery. Two weeks before surgery, the patient was minimally symptomatic. Surgery was deferred, and the patient had an excellent clinical outcome. Cossey et al³ described 7 patients who sustained nondisplaced fractures after resurfacing procedures with the Birmingham prosthesis (Smith & Nephew, London, United Kingdom). Mean time to fracture was 6 weeks (range, 4-14 weeks). All were treated successfully with 4 to 6 weeks of nonweight bearing, followed by 2 to 4 weeks of partial weight bearing. In contrast, Sharma¹³ described a poor functional result (severe varus malunion) with nonoperative treatment of a femoral neck fracture after metal-on-metal resurfacing.

Many authors have addressed the risk factors for postresurfacing femoral neck fractures, including placing the femoral

component in varus,⁶ notching the superior cortex of the femoral neck,^{1,3,5,6,14} not covering all reamed bone with the implant,^{1,3} leaving the femoral neck too long,¹⁵ osteonecrosis,^{5,7} osteolysis,^{2,5} the femoral component creating a stress riser on the femoral neck,^{3,16} unrecognized cysts in the femoral neck,³ and trochanteric osteotomy.^{5,15} Although Shimmin and Back⁶ reported no correlation between surgeon experience and femoral neck fracture, Mont et al¹⁶ and Amstutz et al¹⁷ described a learning curve. In addition, Shimmin and Back⁶ reported a statistically increased relative risk of 1.95 for fracture in women vs men. However, not enough information was available to determine if this difference was related to obesity, bone density, sex-specific anatomic differences, such as the initial neck-shaft angle, or another cause.

Watanabe et al¹⁸ used finite element analysis and 3-dimensional models of the McMinn femoral prosthesis (Corin Medical, Ltd) to study the biomechanical properties of surface arthroplasty. Their model showed that stress shielding occurred in the anterosuperior femoral neck directly beneath the component. Stress concentration existed around the peg, and peak compressive stress occurred along the posteroinferior prosthesis margin. In a biomechanical study of the Birmingham prosthesis, Ong et al¹⁹ reported stress shielding around the superolateral shell regardless of whether the component was fixed to the bone. In addition, inferomedial bone resorption was predicted only when the femoral component was stabilized. Similarly, increased strain existed around the distal stem. This stress distribution may explain the fracture patterns seen clinically and in the laboratory.^{14,19} Beaulé et al²⁰ reported femoral neck thinning with time, a finding of unclear clinical significance that could reflect a remodeling process. Whether cortical thinning is a risk factor for fracture is unknown.

Most periprosthetic femoral neck fractures have been treated with conversion to THA. To the authors' knowledge, other

than the current 7 cases, there have been only 8 reported cases of successful nonoperative treatment of a periprosthetic femoral neck fracture after metal-on-metal resurfacing.^{3,12}

The authors reviewed the types of fractures that have occurred after hip resurfacing and developed a simple classification system that can help guide femoral neck fracture treatment in patients with hip resurfacing components: type I, minimally or nondisplaced with the femoral component stable in its original position; type II, angulated but not completely displaced with a shifted femoral component; and type III, completely displaced. For patients with type I fractures, initial nonoperative intervention is recommended: nonweight bearing for 8 weeks followed by 6 weeks of 50% weight bearing, and then progression to full weight bearing as tolerated. These patients have an excellent chance of achieving satisfactory short-term results, and because their components remain stationary and properly positioned, they should be able to achieve the full potential of the procedure (ie, a vigorous lifestyle). For patients with type II fractures (ie, patient 2 and the patient described by Cumming and Fordyce¹²), nonoperative treatment can be discussed. If the patient experiences minimal symptoms or disability from the fracture, this option would likely have some appeal. It is mandatory that the patient be aware of all of the potential risks of this option, such as nonunion, extremity shortening, and shortened THA life expectancy. If the cup is properly positioned, it is not clear that varus positioning of the femoral component will lead to an increase in metal ion production. However, this possibility should be discussed. For patients with type III fractures, revision is required.

CONCLUSION

The healing of a femoral neck fracture after metal-on-metal hip resurfacing may be achieved with nonoperative interventions. The authors' classification scheme

may help guide decision making for this uncommon complication. 

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