Femoral Head Avascular Necrosis Is Not Caused by Arthroscopic Posterolateral Femoroplasty

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abstract

This study was conducted to identify the risk of avascular necrosis of the femoral head after arthroscopic femoroplasty extending to the posterolateral femoral neck, the source of the primary blood supply to the femoral head. Cam lesions of femoroacetabular impingement are typically anterior along the junction of the femoral head and neck. However, anatomic variations can involve the posterolateral vascular region of the femoral head and neck. Femoroplasty involving this vascular region can lead to injury to the blood supply to the femoral head, with subsequent avascular necrosis. If the posterolateral portion of the cam lesion is preserved, persistent femoroacetabular impingement may occur. A retrospective review identified 112 patients who underwent arthroscopic femoroplasty for femoroacetabular impingement over a 2-year period. Of these patients, 14 had femoroplasty that extended to the posterolateral femoral head. Of this group, 5 had undergone magnetic resonance imaging (MRI) after femoroplasty and the other 9 were contacted to undergo MRI of the hip to evaluate for avascular necrosis. A radiologist and the senior author evaluated all MRI scans specifically for avascular necrosis of the femoral head. All procedures were performed by the senior author. Mean age of the 14 patients (8 women and 6 men) with femoroplasty that extended into the posterolateral vascular region of the femoral head was 44 years (range, 23-69 years). All 14 patients underwent MRI evaluation of the affected hip a mean of 25 months (range, 7-44 months) after femoroplasty. No MRI scans showed evidence of avascular necrosis of the femoral head. Femoroplasty of the posterolateral vascular region of the femoral head is not associated with avascular necrosis. Patients with femoroacetabular impingement and a cam lesion extending to the posterolateral femoral head can undergo femoroplasty of this region without the development of avascular necrosis. [Orthopedics. 2016; 39(3):177-180.]

Femoroacetabular impingement has been recognized as a cause of hip pain that can lead to hip osteoarthritis.1-3 Femoroacetabular impingement can result from bone deformity that involves the femoral head and neck region, a cam lesion, or a pincer lesion of the acetabulum. The classic cam lesion has been reported to be along the anterior region of the femoral head and neck.4 More recently, the cam deformity has been found to have anatomic variations that can extend beyond the anterior region of the femoral head and neck.4-8 Recognition of these anatomic variations is important for effective surgical treatment of symptomatic femoroacetabular impingement because persistent symptoms of femoroacetabular impingement after surgical intervention with osteochondroplasty may be attributed to residual cam or pincer lesions.9 Leunig et al10 described femoroacetabular impingement with extension of the nonspherical portion of the femoral head to the posterolateral region of the head and neck and the need for careful osteochondroplasty of this region to protect the blood supply to the femoral head.
One concern in hip arthroscopy is the potential for avascular necrosis if the blood vessels supplying the femoral head are damaged. The source of the primary blood supply to the femoral head is the deep branch of the medial femoral circumflex artery.11 This artery terminates as lateral retinacular vessels that penetrate the femoral head at the posterolateral junction of the head and neck. The lower incidence of avascular necrosis after hip arthroscopy is rare, the incidence could theoretically increase if femoroplasty to extend beyond the classic location of the femoral neck becomes more common.13-16 As the understanding of femoroacetabular impingement increases, anatomic variations of cam lesions may require femoroplasty to extend beyond the classic location of the anterior femoral neck. Because magnetic resonance imaging (MRI) is the most sensitive test for detecting avascular necrosis of the femoral head, this imaging modality was used for postoperative evaluation of this study group.17,18 The goal of this study was to evaluate patients for avascular necrosis of the femoral head after they underwent arthroscopic femoroplasty of the posterosuperior region of the femoral head and neck for the treatment of femoroacetabular impingement. The study hypothesis was that violation of the posterolateral vasculature penetrating the cam lesion during femoroplasty would not lead to avascular necrosis of the femoral head.

**Materials and Methods**

Between 2010 and 2011, the senior author (R.E.R.) performed hip arthroscopy to treat 120 patients with symptomatic femoroacetabular impingement that was unresponsive to conservative management with arthroscopic femoroplasty. A retrospective review of patient charts identified 14 patients who had femoroplasty that extended to the posterolateral femoral head. Each of these patients also underwent arthroscopic labrum repair. The surgical technique was previously described and started in the peripheral compartment, with the patient in the supine position without initial traction.19 Anterolateral and midanterior portals were used. Traction was applied only during inspection and treatment of the central compartment, including labrum repair. Fluoroscopy was used to confirm removal of the entire cam lesion, and in these 14 patients, the cam lesion extended from the anterior region to the posterolateral region of the femoral head. Arthroscopic visualization confirmed the finding of synovial folds, with the lateral retinacular vessels penetrating the cam lesion (Figures 1-2). To avoid leaving any impinging cam lesion, the surgeon elected to perform femoroplasty contouring of the posterolateral region of the femoral head and neck. This procedure necessitated removal of the penetrating vascularity in this region (Figures 3-4).

Review of patient charts showed that 5 patients had undergone MRI scan since femoroplasty. The other 9 patients were contacted to undergo MRI scan of the hip to evaluate for avascular necrosis. Reasons for MRI evaluation in the 5 patients who had undergone MRI scan included persistent hip pain after the procedure, concern about tearing of the gluteus medius, and evaluation of heterotopic ossification. All MRI scans were performed with...
a 1.5 Tesla GE Signa Creator or Pioneer MRI system (General Electric, Fairfield, Connecticut). All MRI scans were evaluated specifically for avascular necrosis of the femoral head by a radiologist and the senior author.

**RESULTS**

Of the 14 patients with femoroplasty that extended into the posterolateral vascular region of the femoral head, 8 were women and 6 were men. Mean patient age was 44 years (range, 23-69 years). Average operative time was 93 minutes (range, 70-118 minutes). Arthroscopic pump pressure was routinely set at 45 mm Hg but needed to be increased to 65 mm Hg for visualization in 3 cases. Average traction time was 28 minutes (range, 17-45 minutes). All 14 patients underwent MRI scan of the affected hip a mean of 25 months (range, 7-44 months) after femoroplasty. No MRI scans showed evidence of femoral head avascular necrosis.

**DISCUSSION**

The principal finding of this study was that violation of penetrating lateral retinacular vessels at the posterolateral region of the femoral head and neck by femoroplasty for the treatment of femoroacetabular impingement does not cause avascular necrosis of the femoral head. Although rare, avascular necrosis of the femoral head after hip arthroscopy has been reported, and factors including traction, capsulectomy, and injury to the lateral epiphyseal branches of the medial femoral circumflex artery have been implicated in its development. Several authors recommended avoiding femoroplasty or capsular resection about the lateral synovial folds because this area is a landmark of the lateral epiphyseal penetrating branches into the posterolateral femoral head.

In this study, MRI was used to detect avascular necrosis of the femoral head, regardless of symptoms, because asymptomatic avascular necrosis of the femoral head was possible. The authors believed that the average time of 25 months from arthroscopic femoroplasty to MRI scan was adequate to detect avascular necrosis of the femoral head caused by the procedure. The MRI images were evaluated for specific findings of avascular necrosis of the femoral head. One of the earliest signs of avascular necrosis is edema within the marrow that causes diffuse areas of decreased signal intensity on T1-weighted images. Focal findings of ischemic bone include bands or lines in the femoral head that appear thick on T1-weighted images and are adjacent to secondary bands of high signal intensity on T2-weighted images. These findings include the “double-line sign,” which is specific for avascular necrosis. As avascular necrosis progresses, regions of fragmentation and collapse of the femoral head can occur, and images show joint effusion and cartilaginous thinning. The presence of small, asymptomatic lesions of avascular necrosis was considered a possibility in these patients, but no images showed questionable areas of avascular necrosis.

A more common complication of arthroscopic treatment of femoroacetabular impingement is incomplete reshaping of the bony lesions that cause impingement. This is the most frequent reason for revision hip arthroscopy, as reported by Phillipon et al. As the concept of femoroacetabular impingement continues to be refined, there is evidence that the classic cam deformity along the anterolateral region of the femoral head and neck is not the only possible location of the cam prominence. To avoid persistent impingement, surgical treatment of the cam lesion for symptomatic femoroacetabular impingement must address the entire cam lesion. Successful surgical treatment of cam impingement includes recognizing the variations and extent of cam lesions to allow adequate decompression of these lesions without residual deformity.

**Limitations**

This study had several limitations. All arthroscopic femoroplasty procedures were performed by the same surgeon who defined the extension of the cam lesion to the posterolateral region of the femoral neck. The MRI scans were interpreted by several radiologists rather than by a single dedicated musculoskeletal radiologist. In 1 patient, the MRI scan was obtained only 7 months after the procedure, and this may have been too early to detect the development of avascular necrosis. This study did not attempt to compare the results of femoroplasty of the anterior region of the femoral head with femoroplasty that included resection into the posterolateral region of the femoral head. The study attempted only to determine whether avascular necrosis of the femoral head occurs after violation of the posterolateral vasculature of the femoral head as a result of femoroplasty. Another limitation of the study was the small number of patients.

**CONCLUSION**

Hip arthroscopists must understand that it is not necessary to preserve cam lesions that extend to the posterolateral vascular zone of the femoral head to protect the vasculature of the femoral head. These lesions can be treated safely with femoroplasty without causing avascular necrosis of the femoral head.

**REFERENCES**


