Femoral Neck Fracture After Arthroscopic Femoroplasty of the Hip

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abstract

Hip arthroscopy is an increasingly common procedure, particularly for the treatment of femoroacetabular impingement. Various complications have been previously reported, and the authors sought to further evaluate the safety of this procedure. This study was conducted to identify the incidence of femoral neck fracture as well as treatment and outcomes after arthroscopic femoroplasty. In April 2013, a survey was administered to 28 established hip arthroscopists regarding the breadth of their experience, including the total number of hip arthroscopies and proximal femoroplasties performed and the number of postoperative femoral neck fractures. Fracture type, patient age, patient sex, time to fracture, comorbidities, treatments, and outcomes were queried. The study identified 27,200 total arthroscopies and 14,945 proximal femoroplasties performed by the surgeons, with 11 postoperative proximal femur fractures. The incidence of proximal femur fracture after arthroscopic femoroplasty was 0.07%, based on combined data of high-volume hip arthroscopists at multiple medical centers. Mean time to fracture after arthroscopic femoroplasty was 40.5 (±26.6) days postoperatively. The male-to-female ratio was approximately 1:3 for those with fracture, and mean patient age was 52 (±13) years. More than half of the fractures were caused by violation of weight-bearing precautions. All patients had improvement in symptoms after treatment. Femoral neck fracture after arthroscopic femoroplasty is a rare complication for established hip arthroscopists. It is most common in women and patients older than 50 years. Treatment is based on the severity of the fracture, and patients have improved outcomes after treatment. [*Orthopedics*. 2015; 38(8):e696-e700.]

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A recent study of the number of hip arthroscopy cases presented during Part II of the American Board of Orthopaedic Surgeons examination from 1999 through 2009 found an 18-fold increase in the number of procedures during that time.[1] Hip arthroscopy is a relatively new treatment for femoroacetabular impingement, with only short- to midterm follow-up reported.[2-12] Complications of arthroscopic vs open treatment for femoroacetabular impingement are significantly different and warrant consideration before choosing between treatments.[5,6,13-15] Femoral neck fracture after open treatment of femoroacetabular impingement has not been reported. Conversely, the incidence of this complication after arthroscopic treatment has been reported infrequently and requires further examination to better explain the risk.[14,15]

Because of the rarity of femoral neck fracture as a complication, this study was designed as a pilot study to assess the incidence of femoral neck fracture after arthroscopic femoroplasty. The goal of this study was to analyze the incidence, cause, treatment, and outcomes of femoral neck fracture after arthroscopic proximal femoroplasty. Additionally, this study was intended to be a starting point for a multicenter prospective study because the numbers for any single-center series would be insufficient.

Materials and Methods

A survey (**Table 1**) was administered in April 2013 to 29 established hip arthroscopists regarding the breadth of their experience, including the total number of hip arthroscopies and proximal femoroplasties performed and the number of postoperative femoral neck fractures. A similar method was previously reported.[16] Fracture type, patient age, patient sex, time to fracture, comorbidities, treatments, and outcomes were queried and statistically analyzed. A summary of surgeon experience is provided in **Table 2**.

Table 1

Questionnaire Items

1. What is the total number of hip arthroscopies you have performed?
2. What is the total number of your hip arthroscopies that have involved arthroscopic proximal femoroplasty?
3. How many femoral neck fractures (including stress fractures) have you had after arthroscopic proximal femoroplasty? Also, in the same space, please detail specifics of the location and displacement of the fractures, if applicable.
4. If any of your patients have had a femoral neck fracture (of any type) after arthroscopic proximal femoroplasty, how long postoperatively were they at the time of the fracture?
5. If any of your patients have had a femoral neck fracture after arthroscopic proximal femoroplasty, did they have any specific risk factors for fracture or pertinent comorbidities?
6. If any of your patients have had a femoral neck fracture after arthroscopic proximal femoroplasty, what were the age, sex, and body mass index of each patient at the time of fracture (if known)?
7. If any of your patients have had a femoral neck fracture after arthroscopic proximal femoroplasty, how were the patients treated after the fracture (nonoperative treatment, pinning, open reduction and internal fixation, hemiarthroplasty, total hip arthroplasty, etc)?
8. If any of your patients have had a femoral neck fracture after arthroscopic proximal femoroplasty, what were the final outcomes after treatment of the fracture?
9. If any of your patients have had a femoral neck fracture after arthroscopic proximal femoroplasty, what is your expert opinion as to why the fractures occurred in each case?
10. Please list your name and institution.

One surgeon was excluded from analysis because he reported his procedures as the number per year without listing a total number of years in practice. This surgeon reported no femoral neck fractures.

For surgeons who reported the total number of cases in a range, the average of the high and low values was used. For surgeons who reported the number of cases as greater than a certain value, the value listed was used. A few surgeons listed the number of femoroplasties as a percentage of total hip arthroscopies. In these cases, the percentage was multiplied by the total number of hip arthroscopies to establish the number of femoroplasties.

Two patients with fractures did not have specific information listed regarding displacement. Age was not listed for 2 patients. All patients with fractures had values listed for sex, days to fracture, comorbidities, cause of fracture, treatment, and outcome.

Table 2

All Surgeons' Experience With Hip Arthroscopy

Surgery	Case Volume, No.
Hip arthroscopy	
Total	27,200
Average volume of surgeons	971
Median volume of surgeons	700
Range	50-5000
Arthroscopic femoroplasty	
Total	14,945
Average volume of surgeons	534
Median volume of surgeons	488
Range	30-1500

Results

This study identified 27,200 hip arthroscopies, with 14,945 proximal femoroplasties and 11 postoperative proximal femur fractures. The incidence of femoral neck fracture was 0.07%. Fracture types included 6 stress fractures, 2 nondisplaced

Table 3

Comparison of Experience of Surgeons With and Without Femoral Neck Fracture as a Complication

	No.	
Surgery	**Fracture**	**No Fracture**
Hip arthroscopy		
Total	7850	19,350
Average volume of surgeons	1121	920
Median volume of surgeons	900	650
Range	200-2050	50-5000
Arthroscopic femoroplasty		
Total	4120	10,825
Average volume of surgeons	589	516
Median volume of surgeons	500	475
Range	200-1200	30-1500

fractures, 1 displaced fracture, and 2 unidentified fractures. Results are given as mean (±SD). Mean age of patients with a fracture was 52 (±13) years (range, 25-65 years). The male-to-female ratio of patients with a fracture was 3:8. Mean time to fracture was 40.5 (±26.6) days postoperatively (range, 7-90 days). Comparisons of experience with hip arthroscopy between surgeons who did and did not have femoral neck fracture as a complication are shown in **Table 3**. More experienced surgeons did not have a lower fracture rate after arthroscopic femoroplasty. Of the 28 surgeons, 7 accounted for all femoral neck fractures: 4 surgeons reported 2 femoral neck fractures, and 3 surgeons reported 1 fracture.

Multiple correlations were identified postoperatively in patients who had a fracture. Six (55%) patients violated weight-bearing precautions postoperatively, 3 (27%) patients had osteopenia preoperatively, 3 (27%) patients were believed to be poorly selected by the respondents, and 1 (9%) overresection was reported. Of the 6 patients who violated weight-bearing precautions, 2 had a fall that caused the fracture. Additionally, 1 patient was a smoker and 1 had schizophrenia.

Treatment of the fractures varied by surgeon. Three stress fractures were treated nonsurgically. Six fractures (3 stress, 2 nondisplaced, 1 unreported type) were treated with percutaneous screw fixation. Two fractures (1 displaced, 1 unreported type) were treated with total hip arthroplasty; both patients were older than 60 years. All 11 patients had improved pain and function at the most recent follow-up.

Discussion

Previous studies in the basic sciences established that femoral osteochondroplasty lowers the load to failure in vitro. The first study showed that 30% resection in cadaver femurs reduced peak load to failure by 20% compared with control subjects.[17] Using this evidence, the authors recommended no more than 30% resection for the treatment of femoroacetabular impingement. Subsequent cadaveric studies showed that femoroplasty can be reliably performed for cam deformity with arthroscopy compared with open treatment.[18,19] A radiographic study showed that open and arthroscopic techniques are comparable in the treatment of anterior and anterosuperior cam deformities, but open treatment is superior for a posterosuperior cam deformity.[20] Details on osteochondroplasty and irregularities or notching and fracture risk were recently reported.[21] This basic evidence raises the theoretical concern for postoperative fracture after arthroscopic osteochondroplasty, although it is difficult to quantify the risk for patients and providers.

Complications after hip arthroscopy have been reported in the literature and include sporadic reports of femoral neck fracture. Over the past 10 years, overall complication rates have decreased.[2-9,12] In 2003, Clarke et al[13] reported on complications in their first consecutive 1054 cases of hip arthroscopy. They noted 15 (1.4%) complications, with the most common complication being neuropraxia. They reported no incidence of femoral neck fractures. In their review of the literature, no femoral neck fractures had been reported to date. Reported complications included pudendal, sciatic, and lateral femoral cutaneous or femoral neuropraxias; labial hematomas; reflex sympathetic dystrophy; myositis ossificans; portal bleeding; trochanteric bursitis; failure of adequate observation; abdominal pain; infection; and instrument failure.

In 2005, the first report of femoral neck fracture after osteochondroplasty was published as part of a Level IV case series by Sampson.[14] This study reported an overall complication rate of 3.8% in the first 1000 hip arthroscopies performed in the author's practice during the early years of arthroscopic treatment for femoroacetabular impingement. Among other previously reported complications, 1 femoral neck fracture after osteochondroplasty was reported. Discussion of the fracture was limited to its relation to femoroplasty and the possibility of prevention with weight-bearing protection.

Ayeni et al[15] published a case report of femoral neck fracture after arthroscopic femoroplasty for femoroacetabular im-

pingement in 2011. The patient was a 51-year-old man who had an initially uncomplicated postoperative course, with the use of a protective hip orthosis, continuous passive motion from 30° to 70° 3 times daily, and weight bearing of only 20 lb with crutch assistance with the foot flat. Three weeks postoperatively, the patient began walking up to 3 miles a day against the recommendation of his treating physician. At 5 weeks, the patient had anterior hip pain after a physical therapy session. A radiograph showed a nondisplaced basicervical femoral neck fracture. The patient was treated with a locking proximal femoral plate. The fracture went on to heal with a pain-free hip and full range of motion.

To the authors' knowledge, no other reports of femoral neck fracture after arthroscopic treatment of femoroacetabular impingement have been published. The published reports indicate that these fractures, when clinically significant, are characterized by atypical anterior hip pain in the early postoperative period and are easily identified. The scarcity of reported cases, despite large clinical series, inspired the design for the current study as a means of sampling large numbers of cases to gain a starting point for further multicenter trials.

No study has shown the accuracy of self-reported complications of orthopedic surgeons using a questionnaire, although this technique has been used previously.[16] It would be unlikely for a surgeon to overreport complications, but it is feasible that underreporting could occur. A major reason for underreporting was discussed in a recent study evaluating complication rates after total knee arthroplasty.[22] This study found that 45.5% of complications were diagnosed and treated at a different institution than the initial treating institution, a large tertiary referral hospital. This percentage of complications seen at outside hospitals may be an overestimate when applied to a smaller community, which would have fewer hospitals for the patient to present. Adjusting the incidence of femoral neck fractures reported on the authors' survey based on the percentage of patients presenting to outside hospitals in the previous article would increase the percentage of femoral neck fractures from 0.07% to 0.13%.

The major strength of this study was the volume of cases. No study of hip arthroscopy to this point compiled 27,200 hip arthroscopies with 14,945 proximal femoroplasties. The large sample size reduced the risk of sampling error in providing an accurate incidence of femoral neck fracture after arthroscopic femoroplasty.

Limitations

This study had several limitations. A nonrandomized retrospective study has inherent weaknesses compared with randomized prospective studies. Structured prospective studies are more likely to accurately identify patient risk factors, causes of fracture, best treatment options, and outcomes. The use of a survey also has the potential for recall bias from respondents. The authors believed that the rarity of this complication would lead to an accurate recount of the number of cases. Other factors, such as patient characteristics and ultimate outcome, are likely to be subject to recall bias. The timing of the survey did not allow for a formal chart review. Use of data from 28 different surgeons was another limitation because of differences in training backgrounds and experience. The survey included only fellowship-trained surgeons, but they had different levels of experience, with the number of arthroscopic femoroplasties performed ranging from 30 to 1500 (average volume, 534; median volume, 4880). This study was intended to be a pilot study.

Conclusion

Arthroscopic treatment of femoroacetabular impingement showed cadaveric and clinical results and outcomes that were comparable to those with open treatment. Open treatment for femoroacetabular impingement remains the gold standard, although arthroscopic treatment has lower rates of major complications. Femoral neck fracture is a rare complication after arthroscopic femoroplasty. Patients at greatest risk are female, older than 50 years, and likely to violate their weight-bearing restrictions. Treatment options are similar to those for femoral neck fractures from other causes. Patients typically do well, with improvement in symptoms after treatment of femoral neck fracture after arthroscopic femoroplasty.

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