Prevalence of Abnormal Hip Findings in Asymptomatic Participants

A Prospective, Blinded Study

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Background: The prevalence of abnormal magnetic resonance imaging (MRI) findings in an asymptomatic population has yet to be determined.

Purpose: The purpose of this study was to assess a cohort of asymptomatic people to determine the prevalence of hip lesions.

Study Design: Cross-sectional study; Level of evidence, 3.

Methods: Forty-five volunteers with no history of hip pain, symptoms, injury, or surgery were recruited for enrollment in this institutional review board–approved study. The subjects underwent a unilateral MRI scan with a Siemens 3.0-tesla scanner. The extremity side evaluated by MRI was alternated. All MRI scans were reviewed by 3 fellowship-trained musculoskeletal radiologists. The scans were mixed randomly with 19 scans from symptomatic patients to blind the radiologists to the possibility of patient symptoms. An abnormal finding was considered positive when 2 of 3 radiologists agreed on its presence.

Results: The average age of volunteers was 37.8 years (range, 15-66 y); 60% were men. Labral tears were identified in 69% of hips, chondral defects in 24%, ligamentum teres tears in 2.2%, labral/paralabral cysts in 13%, acetabular bone edema in 11%, fibrocystic changes of the head/neck junction in 22%, rim fractures in 11%, subchondral cysts in 16%, and osseous bumps in 20%. Participants older than 35 years were 13.7 times (95% CI, 2.4-80 times) more likely to have a chondral defect and 16.7 times (95% CI, 1.8-158 times) more likely to have a subchondral cyst compared with participants 35 or younger. No other joint lesions were associated with age. Male subjects were 8.5 times (95% CI, 1.2-56 times) more likely to have an osseous bump than female subjects. No other joint lesions were associated with sex.

Conclusion: Magnetic resonance images of asymptomatic participants revealed abnormalities in 73% of hips, with labral tears being identified in 69% of the joints. A strong correlation was seen between participant age and early markers of cartilage degeneration such as cartilage defects and subchondral cysts.

Keywords: acetabular labrum; asymptomatic; abnormal findings

Management of the causes of nonarthritic hip pain has traditionally focused on nonoperative measures. However, recent advances in the understanding of treatable causes of hip pain, combined with improved operative techniques and surgical instrumentation, have led to an increase in the applications for arthroscopic surgery for hip conditions.[5,15,23] Current indications for hip arthroscopy include acetabular labral tears, femoroacetabular impingement (FAI), chondral lesions, hip capsular laxity and instability, ligamentum teres disorders, loose bodies, synovial proliferative disorders, osteochondritis dissecans, abductor tears, and internal and external snapping hips.[5,15,23] Although previously thought to be uncommon, many of these disorders are being diagnosed with increasing frequency because of improved clinical understanding as well as better imaging and surgical techniques.

Traditionally, magnetic resonance arthrography (MRA) has been used to diagnose lesions of the acetabular labrum.[7,30] However, recent reports have shown similar

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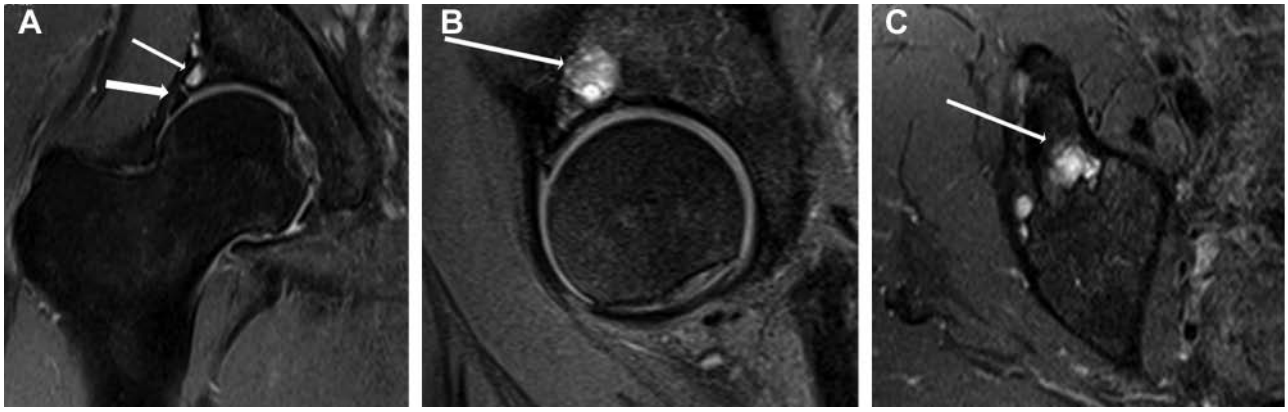

Figure 1. (A) Coronal MRI showing acetabular labral tear (wide arrow) and paralabral cyst (small arrow) in an asymptomatic participant. (B) Sagittal MRI in same participant revealing acetabular subchondral cyst. (C) Axial image in the same participant.

accuracy when MRA is compared with magnetic resonance imaging (MRI), especially when an optimized hip protocol and 3.0-T magnets are used.[17,21,27] The presence of acetabular labral tears in athletic patients with hip or groin pain has been reported to range from 22% to 55%,[16,18] and MRA has shown excellent sensitivity in the diagnosis of labral tears in patients with hip symptoms.[7,28] Conversely, the prevalence of hip lesions in asymptomatic people remains unknown.[1,24]

The purpose of this study is to document the prevalence of abnormal hip findings in asymptomatic participants by means of a 3.0-T noncontrast MRI with an optimized hip protocol. We anticipate that this information will improve treatment and decision making for physicians when evaluating patients with abnormal hip imaging findings.

MATERIALS AND METHODS

Volunteers were recruited for this internal review board–approved study. People were recruited from the community through word of mouth. No volunteers were paid. The recruitment area was a rural county in the western United States. The population of the county is approximately 29,000. The state health information data set indicated that 88% of people in the county were active in leisure-time physical activity and 10% were obese in the year of this study. The volunteers were screened with a standardized questionnaire, and only those with no history of pain, injury, or surgery were included in this study. Participants were also excluded if they had claustrophobia or a contraindication to obtaining an MRI. Forty-five people volunteered for the study, met the inclusion/exclusion criteria, and underwent an MRI. The average age of the volunteers was 38 years (range, 18-66 y), and there were 28 men and 17 women.

The volunteers underwent an MRI using a Siemens 3-T magnet. All participants were placed supine with a surface coil placed over the hip. As MRIs were performed, we alternated between participants' right and left hips. The volunteer had no choice in which hip had an MRI. An MRI of the asymptomatic hip was performed with an oblique axial proton density, turbo spin echo with fat suppression (FS) sequence (repetition time 2750 ms; echo time 33 ms; number of excitations = 2; 16 × 16-cm field of view; matrix 640 × 640), oriented along the axis of the femoral neck and head of the hip. The femoral head/neck offset and the hip alpha angle were calculated, and an osseous (cam) bump was identified. A limited axial gradient echo scout sequence of the knee was performed immediately after the hip MRI examination with the volunteer in the same unmoved position within the scanner to determine the angle of the femoral head/neck axis relative to the intercondylar line tangential along the posterior margins of the femoral condyles at the knee to measure femoral anteversion. Three musculoskeletal radiologists who had completed 3 different musculoskeletal fellowships and who practice at 3 different institutions read all of the images.

Nineteen MRI scans from patients of similar age who had hip symptoms were randomly included in this study to blind the radiologists to the presence of patient symptoms. Radiologists were asked to comment on the presence or absence of the following hip lesions: labral tears (Figures 1A and 2), chondral defects, ligamentum teres tears, labral/paralabral cysts (Figure 1A), acetabular bone edema, fibrocystic changes of the head/neck junction, rim fractures (Figure 2), subchondral cysts (Figure 1, B and C), and osseous bumps at the femoral head/neck junction. A forced choice recording sheet was used to document the findings to minimize inadvertent omission of certain observations. The responses of each radiologist were compared, and a lesion was considered to be present only when at least 2 of the readers agreed.

An independent samples t test was used to compare continuous variables between 2 groups. Alpha angle, center edge angle, version, and age were normally distributed (Kolmogorov-Smirnov test, $P > .05$). The Pearson correlation coefficient was used to compare 2 continuous variables.

RESULTS

Of the asymptomatic volunteers, 73% had some abnormality that was detected on their hip MRI (Table 1).

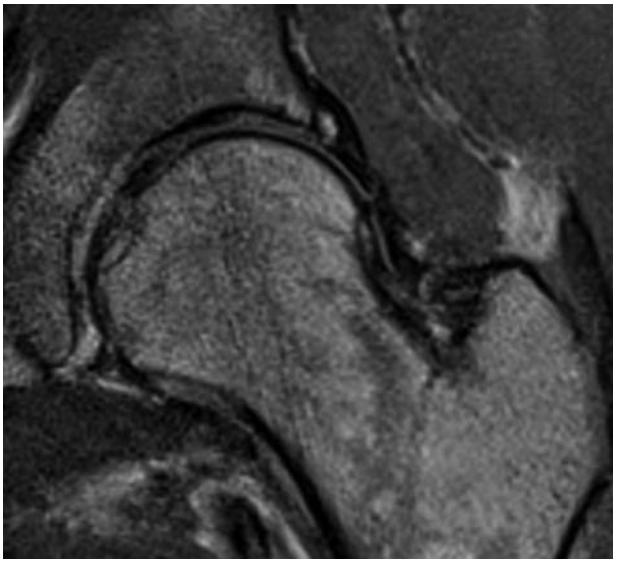

Figure 2. Coronal image depicting acetabular rim fracture with underlying acetabular edema and a labral tear.

Labral tears were the most frequently identified intra-articular hip lesions, being noted in 69% of hips (Figure 1A). In order of decreasing frequency, the following abnormalities were identified: chondral defects in 24% of hips, fibrocystic changes of the head/neck junction in 22%, osseous bumps in 20%, subchondral cysts in 16%, labral/paralabral cysts in 13%, acetabular bone edema in 11%, rim fractures in 11%, and ligamentum teres tears in 2.2%. The mean alpha angle of the volunteers was 60.7° (standard deviation [SD], 7.3°; range, 45°-74°). The mean center edge angle was 31° (SD, 5.5°; range, 14°-42°), and the mean femoral anteversion was 16.3° (SD, 8.1°; range, 7°-28°).

Age of the volunteers was shown to correlate with the presence of a labral tear (P = .013) and cartilage degeneration (P = .002). Participants older than 30 years were 8.1 times (95% CI, 1.9-37.5 times) more likely to have a labral tear. Participants older than 35 years were 13.7 times (95% CI, 2.4-80 times) more likely to have a chondral defect and 16.7 times (95% CI, 1.8-158 times) more likely to have a subchondral cyst compared with the participants who were 35 years or younger. No other hip abnormality was associated with age.

Volunteers' sex was shown to associate with proximal femur morphologic variability. Male participants were 8.5 times (95% CI, 1.2-56 times) more likely to have an osseous bump of the neck compared with female participants. No other joint abnormality was associated with sex.

The alpha angle was higher in participants with labral tears (63° vs 58°; P = .039). The alpha angle was also significantly higher in volunteers with chondral defects (68° vs 59°; P = .00001), fibrocystic changes of the head/neck junction (67° vs 60°; P = .004), osseous bumps (71° vs 59°; P = .0001), and subchondral cysts (67° vs 60°; P = .015). No other changes were associated with alpha angles.

There was an association between the presence of a labral tear and a chondral defect (P = .028), a labral tear and fibrocystic changes of the head/neck junction (P = .048), a labral tear and a subchondral cyst (P = .026), and a labral tear and an osseous bump (P = .007). In participants with FAI bony abnormalities (osseous bumps, fibrocystic changes of the femoral head/neck junction, and/or acetabular rim edema), 95% of participants also had a labral tear. Chondral defects were associated with acetabular bone edema (P = .009), fibrocystic changes of the head/neck junction (P = .014), rim fractures (P = .047), subchondral cysts (P = .0001), and osseous bump (P = .001). Acetabular bone edema was associated with labral cysts (P = .039). An osseous bump was associated with fibrocystic changes of the head/neck junction (P = .003) and subchondral cyst (P = .003). A rim fracture was associated with fibrocystic changes of the head/neck junction (P = .004).

DISCUSSION

In this study, 73% of participants had an abnormality that was revealed by 3-T MRI of the hip, with 69% having a labral tear. This finding that an asymptomatic volunteer has a greater than 50% chance of having a labral tear emphasizes the danger of making clinical decisions to operate on the sole basis of a diagnostic test without clinical information. In addition, this study showed an association between cam impingement and labral and chondral lesions. A relatively high percentage of hip bony abnormalities have been reported on radiographs and computed tomographic scans in asymptomatic people.[9,10,13,22] This supports previous research that has shown a relationship between FAI and the development of chondrolabral dysfunction. It is unclear, however, when and why this conflict causes symptoms, because impingement and intra-articular lesions due to impingement were shown in this study in asymptomatic volunteers.

Our results show a higher prevalence of labral tears than that which has been reported previously. In a recent review of 39 asymptomatic college and professional hockey players undergoing 3-T MRI, 56% of participants were found to have an acetabular labral tear.[25] Although average age was not described in this study, this cohort presumably had a lower average age than our participants, which possibly explains the lower rate of labral tears. Another study showed that 95% of college football players had at least one sign of cam or pincer FAI.[14] As opposed to the elite athletes in these studies, our participants were active but were not involved in elite-level athletics or competition. This population better reflects what most orthopaedic surgeons see in their clinic.

Other studies have also shown a high rate of labral abnormalities. McCarthy et al[16] reported on the findings at arthroscopy in 436 symptomatic patients with an average age of 37.4 years. The authors found that 55% of patients had arthroscopically identifiable labral tears. It is possible that the increased sensitivity of modern 3-T MRI scanners allowed us to identify degenerative labral tissue or intralabral cysts that may not be visible

TABLE 1
Findings From Each Radiologist's Reading of MRIs[a]

	Reader 1	Reader 2	Reader 3	Consensus, No. (%)
Labral tear	41	30	17	31 (69)
Chondral defect	17	10	5	11 (24)
Ligamentum teres tear	5	2	1	1 (2.2)
Labral/paralabral cyst	9	9	5	6 (13)
Acetabular bone edema	10	6	2	5 (11)
Fibrocystic changes of the femoral head/neck junction	19	10	6	10 (22)
Rim fracture	5	7	1	5 (11)
Subchondral cysts	10	6	7	7 (16)
Osseous bump of the femoral neck	11	10	8	9 (20)

[a]Values are expressed as number of participants unless otherwise indicated.

arthroscopically, explaining the higher number of such abnormalities in our study.

The acetabular labrum has many functions in the adult hip, including pressure distribution, joint lubrication, stability, shock absorption, and maintenance of a "suction seal."[6,11] Labral tears have been associated also with osteoarthritis, as part of the same continuum of disease.[12] Labral tears were first described by Paterson[19] in 1957 and until recent decades were thought to be relatively uncommon.[8] However, improved imaging and surgical techniques, combined with a better understanding of the causes of hip pain, have led to an increase in the diagnosis of labral tears and other causes of hip pain. The prevalence of labral tears in symptomatic patients with groin pain has been reported to be 22% to 55%, but the prevalence of labral tears in asymptomatic patients has not previously been well described.[11,16,18]

Although cadaveric studies have shown high rates of labral abnormalities in an elderly population, the high rates in this study even in participants younger than 40 years was surprising. Sixty percent of the participants in our study were younger than 40, and 85% of those had labral tears. Are these participants presymptomatic with silent disease that may go on to osteoarthritis, or do these MRI findings indicate the normal aging process? In the early years of shoulder arthroscopy, anterosuperior labral foramens were sometimes misinterpreted as pathologic tears instead of normal variants. Whether a similar process is occurring regarding the hip is unclear. Further investigation into this issue will be necessary to better understand what is normal and what is pathologic. Additionally, does the MRI appearance of the normal labrum need to be better defined? We also found that 24% of asymptomatic participants had a chondral lesion. Future studies should attempt to determine whether and when asymptomatic participants with positive findings such as a labral tear, chondral lesion, or osseous bump are more likely to become symptomatic than participants with a normal labrum.

The causes of acetabular labral tears are multifactorial. Causes include trauma, dysplasia, FAI, and degenerative and idiopathic causes. The relationship between FAI and labral tears has been well described.[12,20,29] These studies found that 49% to 87% of patients with labral tears had bony changes consistent with FAI. Our results showed that among participants with FAI bony abnormalities (osseous bumps, fibrocystic changes of the femoral head/neck junction, and/or acetabular rim edema), 95% of participants also had a labral tear. Asymptomatic people with FAI and the presence of a labral tear and/or a chondral lesion may be more likely to develop symptoms than asymptomatic people with isolated labral or chondral lesions; however, it is unclear when this becomes symptomatic. This information needs to be addressed and may prove to be valuable in the future as patients may be screened for FAI and the risk of developing hip disease.

The prevalence of abnormal findings in asymptomatic participants is vital information for physicians who are trying to develop a treatment plan for patients with hip pain.[1,24] This information has been collected for many other anatomic areas, including the cervical spine, the lumbar spine, and the knee, but before this study it remained unknown in the hip.[2-4] Perhaps this is because MRA has traditionally been the diagnostic test of choice for acetabular labral tears, and researchers are less likely to perform a prevalence study when invasive tests are necessary. Controversy remains as to the best imaging technique for the diagnosis of acetabular labral tears.[26,28] We chose to use 3-T MRI with an optimized hip protocol as a screening tool for hip lesions based on recent reports showing similar diagnostic accuracy between MRA and 3-T MRI, and this test is used almost exclusively in our institution for the diagnosis of hip conditions.[17,21,27] The 3-T scanner gives greater confidence in anatomic findings, but the question of differentiations of normal variants versus pathological findings remains. This question is highlighted by the variability noted between our 3 radiologists. With only 1 radiologist reading hip MRI scans at most institutions, a reproducible definition of normal and abnormal findings is imperative.

Our study has some limitations. This cohort may not reflect an adult population at large. Our facility is located in a ski town with a very active population that may put these volunteers at risk for hip injury. Conversely, it is not known whether obesity predisposes people to labral lesions. Because most of our asymptomatic participants had normal body weight, this cohort may actually underestimate the prevalence of hip lesions. Our study did not

address the prevalence of pincer impingement. Because there is no commonly used technique to assess pincer on MRI, we did not address this. Finally, although all of the participants reported no symptoms, some participants may have not disclosed all of their symptoms because they wanted to get an MRI. Results of the MRI were not shared with the volunteers.

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