Research Square

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Clinical Outcomes of Physiotherapy for Patients with Acetabular Labral Tears: An Analysis According to Severity of Injury

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Abstract

Background: Arthroscopic labral repair is an effective treatment for femoroacetabular impingement (FAI) and acetabular labral injury. However, the effectiveness of physiotherapy treatment is controversial. Previous studies that analyzed the outcome of physiotherapy for patients with FAI or acetabular labral tears did not consider damaged tissues or the severity of the acetabular labral tear. This study aimed to evaluate (1) the short-term outcome of physiotherapy in patients with acetabular labral tears confirmed by magnetic resonance imaging (MRI) and (2) the effectiveness of physiotherapy according to the severity of the labral tear.

Methods: Thirty-five patients who underwent physiotherapy for symptomatic acetabular labral tears from August 2013 to July 2018 were enrolled. We evaluated the severity of the acetabular labral tears, which were classified based on the Czerny classification system using 3-T MRI. Clinical findings of microinstability and extra-articular pathologies of the hip joint were also examined. Outcome scores were evaluated using the International Hip Outcome Tool 12 (iHOT12) at pre- and post-intervention.

Results: The mean iHOT12 score significantly improved from 44.0 to 73.5 in 4.7 months. The post-intervention iHOT12 scores were significantly higher than the pre-intervention scores at stages I (pre 51.0, post 74.4; P=0.004) and II (pre 44.8, post 81.2; P<0.001). However, there were no significant differences between the pre-intervention and post-intervention iHOT12 scores at stage III (pre 36.6, post 60.8; P=0.061). Furthermore, 7 patients (20.0%) had positive microinstability tests, and 22 (62.9%) had findings of extra-articular pathologies. Of 35 patients, 8 (22.9%) underwent surgical treatment after failure of conservative management, of whom 4 had Czerny stage III.

Conclusions: Physiotherapy significantly improved the iHOT12 score of patients with acetabular labral tears in the short-term period. In patients with severe acetabular labral tear, improvement of clinical score by physiotherapy may be poor. Identifying the severity of acetabular labral tears can be useful in determining treatment strategies.

Background

The hip acetabular labrum contributes to the stability of the hip joint by deepening the cover of the acetabulum and providing a sealing effect [1, 2]. Abnormal bone morphology, such as femoroacetabular impingement (FAI) or acetabular dysplasia, and hip joint dysfunction are factors that increase the load on the acetabular labrum [3, 4]. Damage to the acetabular labrum may cause inguinal pain and joint instability [5, 6].

Arthroscopic labral repair has recently become common, and excellent outcomes have been reported from many facilities [7, 8]. Regarding the conservative therapy, however, there is no consensus on the usefulness of physiotherapy to treat acetabular labral tears. Previous studies reported that physiotherapy can improve clinical symptoms [9–11], but outcome scores of conservative treatments have been reported to have no difference or to be significantly lower than those of arthroscopic surgery [12, 13].

Many tissues around the hip joints may cause inguinal pain [14], and multiple pathologies may coexist [15]. Furthermore, abnormal bone morphologies, such as pincer and cam deformity, have been reported in asymptomatic individuals [16, 17]. Nonetheless, in previous studies that referred to conservative therapy for acetabular labral tear, diagnosis was given based on bone morphology, and the assessment of damaged tissue was insufficient. The purpose of the present study was to investigate the short-term clinical outcome of physiotherapy in patients with acetabular labral tears that were confirmed by magnetic resonance imaging (MRI). Additionally, we evaluated the effectiveness of physiotherapy according to the severity of the acetabular labral tear.

Methods

Participants and Search Procedure

The Institutional Review Board of Sapporo Medical University Hospital approved the study; informed consent was obtained from each participant and the rights of participants were protected. We retrospectively reviewed the records of 107 patients who underwent physiotherapy for hip pain in our hospital from August 2013 to July 2018. Of these, patients who were diagnosed with acetabular labral tear were included in this study. The inclusion criteria were symptomatic patients who had acetabular labral tears confirmed by 3-T MRI and who underwent physiotherapy for more than 2 months.

A total of 72 patients were excluded from the study due to osteoarthritis (Tönnis grade ≥2; n = 28), developmental dysplasia of the hip (lateral center-edge angle [LCEA] < 20°; n = 4), spinal disease (n = 3), hip dislocation (n = 2), tumor (n = 2), injury from traffic trauma (n = 2), femoral head necrosis (n = 1), septic arthritis of the pubic symphysis (n = 1), rheumatoid arthritis (n = 1), juvenile idiopathic arthritis (n = 1), tuberculous arthritis (n = 1), intervention period < 2 months (n = 15), lack of MRI evaluation (n = 8), and lack of follow-up (n = 3) (Fig. 1). The study population comprised 13 male and 22 female patients with a mean age of 43.0 ± 17.3 years (range, 11–72 years). The mean follow-up period was 4.7 ± 2.1 months (range, 2–9 months), and the mean physiotherapy session per month was 3.3 ± 1.4 times (range, 1.7–7.7 times). The patients' demographic data are shown in Table 1.

Table 1
Patient information

		Stage of Czerny classification			Total	*P* value
		I	□	□		
n		9	16	10	35	-
Age (y)		33.0 ± 18.0	42.6 ± 18.7	49.8 ± 10.7	43.0 ± 17.3	0.093
Sex	Male	3	6	4	13	-
	Female	6	10	6	22	-
Height (cm)		162.7 ± 9.8	161.1 ± 6.0	163.7 ± 8.7	162.4 ± 7.6	0.670
Weight (kg)		57.9 ± 11.6	57.7 ± 9.9	62.9 ± 16.2	59.2 ± 12.2	0.903
Body mass index		21.6 ± 2.4	22.2 ± 3.4	23.2 ± 4.1	22.3 ± 3.3	0.695
Radiological diagnoses	Pincer-type FAI	1	3	3	7	-
	Cam-type FAI	1	5	1	7	-
	Mixed-type FAI	2	3	1	6	-
	Borderline dysplasia	2	4	2	8	-
	Normal	3	1	3	7	-

Abbreviation: FAI, femoroacetabular impingement

Clinical Evaluation and Imaging

We obtained the International Hip Outcome Tool 12 (iHOT12) score at the first (pre-intervention) and final (post-intervention) treatments. The prone external rotation test and the traction test were performed to assess the microinstability of the hip joint. The prone external rotation test was performed with the patient in a prone position and the affected hip in maximal external rotation; then the examiner pushed the greater trochanter anteriorly to translate the femoral head [18, 19]. The traction test is the senior author's preferred method for detecting inferior laxity of the hip joint. The relationship between hip joint distraction by axial traction and microinstability has been reported previously [20, 21]. This test was conducted by pulling the patient's lower limb to separate the femoral head from the acetabulum. If the patient felt apprehension, the test was considered positive.

Extra-articular pathologies, including adductor-, iliopsoas-, inguinal-, and pubic-related groin pain, were also evaluated according to the diagnostic criteria of the Doha agreement [22]. Anterior inferior iliac spinitis (AIISpinitis), recently reported by Kaya, is tendinosis of the direct head of rectus femoris muscle

and is associated extra-articular inflammatory pathology [23]. If patients had anterior hip pain according to Patrick's test and had tenderness at Scarpa's triangle, the diagnosis of AIISpinitis was suspected.

All radiographs and MRI images were assessed by a hip surgeon. The patients were diagnosed with acetabular dysplasia if the LCEA was less than 20° or with borderline dysplasia if the LCEA was between 20° and 25° [24, 25]. Radiographic FAI subtypes were classified as cam, pincer, or combined. Cam type was defined as head/neck offset ratio < 0.14, deformity of pistol grip, or herniation pit, in addition to an alpha angle > 55° on any radiographic, computed tomography, or MRI image. Pincer type was defined as LCEA ≥40°, LCEA ≥30° and acetabular roof obliquity ≤ 0°, or LCEA ≥25° and a positive crossover sign. The severity of acetabular labral tear was also evaluated based on the Czerny classification from 3-T MRI radial or coronal slice images. The Czerny classification was based on the presence or absence of intrasubstance degeneration, tear, and detachment [26], which were as follows: stage I, intrasubstance degeneration; stage II, labral tear; and stage III, labral detachment. In this study, the Czerny classification was stage I in 9, II in 16, and III in 10 (Table 1). The radiological diagnoses were FAI in 20 (pincer, 7; cam, 7; mixed, 6), borderline dysplasia in 8, and normal in 7.

Rehabilitation Protocol

The rehabilitation protocol used for this study consisted of patient education, including activity modification and improvement of mobility and/or stability. Before the beginning of the intervention, 6 patients stopped their sports activities because of groin pain, and 3 patients continued their sports activities despite groin pain. All patients were instructed to refrain from any activities of daily living and sports activities causing groin pain during the intervention period.

The physiotherapy plan was established according to the patients' symptoms and physiological findings, including mobility restriction and loss of stability. To improve mobility, we performed muscle stretching and joint mobilization related to the hip, pelvic girdle, and lumbar spine. To improve stability, we recommend exercises that improve hip joint and trunk muscle strength, coordination, and movement stabilization. If the microinstability test was positive, acquisition of femoral head centripetal position was carried out for the acetabulum. Rehabilitation was provided by 3 physiotherapists at once or twice a week.

Statistical Analysis

All data are presented as mean and standard deviation. The Shapiro-Wilk test of normality and the Levene test of homogeneity of variance were performed on all continuous data. The differences in patients' pre-intervention parameters were evaluated by Kruskal-Wallis tests. The Wilcoxon signed-rank test was used to compare the pre-intervention iHOT12 scores with the post-intervention iHOT12 scores for each Czerny classification stage and bony deformity type. We also compared age, body mass index, follow-up duration, and number of physiotherapy sessions per month between patients who only received physiotherapy (non-surgical group) and those who underwent surgery (surgical group). The level of significance was set at $P < 0.05$. Statistical analyses were performed using JMP® version 14.0.0 (SAS Institute, Cary, NC, USA).

Results

Short-Term Outcome of Physiotherapy

With physiotherapy, the mean iHOT12 score of 35 patients with acetabular labral tears significantly improved from 44.0 (20.6) to 73.5 (22.1) ($P < 0.001$) in 4.7 months. Of these 35 patients, 8 (22.9%) underwent surgical treatment after failure of the conservative therapy. There were no significant differences in age, body mass index, follow-up duration, or number of physiotherapy sessions per month between the non-surgical and surgical groups (Table 2). The mean iHOT12 score in the non-surgical group improved significantly from 45.4 to 80.6 ($P < 0.001$). Although the scores in the surgical group increased from 39.5 to 50.3, this improvement was not significant ($P = 0.110$). The post-intervention iHOT12 scores of the surgical group were significantly lower than those of the non-surgical group ($P < 0.002$).

Table 2
Characteristics of patients in the non-surgical group and the surgical group

		Non-surgical group	Surgical group	*P* value
n		27	8	
Age (y)		42.7 ± 17.9	40.4 ± 16.0	0.568
Body mass index		21.9 ± 3.2	23.7 ± 3.8	0.356
Follow-up periods (months)		4.8 ± 2.2	4.5 ± 1.8	0.843
Physiotherapy session per month		3.1 ± 1.1	4.3 ± 1.9	0.054
iHOT12	Pre	45.4 ± 22.6	39.5 ± 11.5	0.387
	Post	80.6 ± 17.6	50.3 ± 20.6	0.002
Abbreviation: iHOT12, International Hip Outcome Tool 12				

Effectiveness of Physiotherapy According to Labral Tear Severity

Table 3 shows the clinical findings for each stage of the Czerny classification. Of 35 patients, 7 (20.0%) had positive microinstability tests. Of these, 4 patients had Czerny stage III. Twenty-two patients (62.9%) had findings of extra-articular pathologies. Tenderness and resisted pain around the hip joint, classified based on the Doha agreement, were found in 7 patients (20.0%). In addition, 12 patients (34.3%) had AIISpinitis. The other findings were iliopsoas snapping in 2 patients (5.7%), tenderness and motion pain of the sacroiliac joint in 1 (2.9%), tenderness and resisted pain of the muscles (quadriceps, hamstrings,

sartorius, and gluteus minimus muscles) in 5 (14.3%), and tenderness of the greater trochanter and pain during hip abduction in 1 (2.9%).

Table 3
Patient clinical findings and Czerny classifications

		Stage of Czerny classification			Total
		I	□	□	
Microinstability		1	2	4	7
Iliopsoas-related lesions		2	3		5
Inguinal-related lesions		1			1
Pubic-related lesions			1		1
AIISpinitis		4	7	1	12
Others	Iliopsoas snapping		2		2
	Tenderness and motion pain in the sacroiliac joint	1			1
	Tenderness and resisted pain in muscles		3	2	5
	Tenderness in the greater trochanter and pain during hip abduction		1		1

Abbreviation: AIISpinitis, anterior inferior iliac spinitis

The mean iHOT12 scores according to each Czerny classification stage and bony deformity type are shown in Table 4. The post-intervention iHOT12 scores were significantly higher than the pre-intervention scores for Czerny stages I ($P = 0.004$) and II ($P < 0.001$). However, there was no significant difference between the pre-intervention and post-intervention iHOT12 scores for Czerny stage III ($P = 0.061$). In contrast, the post-intervention iHOT12 scores were significantly higher than the pre-intervention iHOT12 scores for all bony deformity types.

Table 4
Pre-intervention and post-intervention iHOT12 scores according to the Czerny classification stage and bony deformity type

		iHOT12		
		Pre	**Post**	P **value**
Total		44.0 ± 20.6	73.6 ± 22.1	< 0.001
Czerny classification stage				
I		51.0 ± 25.7	74.4 ± 20.5	0.004
II		44.8 ± 18.7	81.2 ± 15.8	< 0.001
III		36.6 ± 18.1	60.8 ± 28.0	0.061
Bony deformity type				
FAI	Pincer-type	52.9 ± 16.6	81.4 ± 20.8	0.031
	Cam-type	46.0 ± 23.7	74.7 ± 16.9	0.016
	Mixed-type	33.5 ± 16.0	70.0 ± 26.0	0.031
Borderline dysplasia		37.4 ± 15.8	75.6 ± 25.3	0.016
Normal		49.9 ± 27.6	65.1 ± 24.6	0.031
Abbreviations: iHOT12, International Hip Outcome Tool 12; FAI, femoroacetabular impingement				

Of the eight patients who underwent surgery, four patients (50.0%) had Czerny classification stage III tears (Table 5). Patients in cases 1 and 2 underwent surgical treatment because they had severe extra-articular symptoms. Half of the patients with Czerny stage II and III tears who underwent surgery had microinstability.

Table 5
Characteristics of patients who underwent surgical treatment

	Age	BMI	iHOT12		Bony deformity	Czerny classification	Clinical findings
			Pre	Post			
Case 1	16	23.4	25	29	Mixed	I	Sacroiliac joint pain
Case 2	18	24.3	48	50	Mixed	II	Iliopsoas-related lesions AIISpinitis
Case 3	35	21.9	35	58	Borderline dysplasia	II	
Case 4	42	21.2	59	67	Normal	II	Microinstability
Case 5	50	22.2	39	58	Normal	III	
Case 6	51	18.8	40	36	Pincer	III	
Case 7	55	25.9	45	83	Pincer	III	Microinstability
Case 8	56	31.6	25	21	Borderline dysplasia	III	Microinstability

Abbreviations: BMI, body mass index; iHOT12, International Hip Outcome Tool 12; AIISpinitis, anterior inferior iliac spinitis

Discussion

To our knowledge, this is the first study to examine the short-term outcome of physiotherapy in patients with acetabular labral tears. Our study demonstrated two major findings. First, when considering the entire cohort of patients with acetabular labral tears, physiotherapy significantly improved the iHOT12 score. Second, when the severity of the tear is considered, the iHOT12 score of patients with severe acetabular labral tears did not significantly improve.

In recent years, several studies on conservative treatment for patients with acetabular labral tears and FAI have been reported [9–11]. However, the diagnostic accuracy of acetabular labral tear was relatively low in most studies because the diagnosis of labral tear was only dependent on bone morphology and anterior impingement test. Pennock et al. [11] reported the results of conservative treatment for symptomatic FAI patients, and when they performed MRI in 55% of the patients, they found that 22% had no acetabular labral tear. In this study, all patients were evaluated by 3-T MRI, which effectively visualized and confirmed the acetabular labral tear [27]. We believe that the diagnostic accuracy of the labral tear is higher in this study than in other studies.

Recently, several randomized controlled trials on conservative treatment for FAI patients have been reported. Griffin et al. [12] conducted a multicenter randomized trial examining the outcome of hip arthroscopy compared with the best conservative care. They reported that conservative treatment significantly improved the iHOT33 scores, but the post-intervention iHOT33 score was only 49.7. Mansell et al. [13] also compared the results of physiotherapy and arthroscopy in a military population. They reported that conservative treatment significantly improved the iHOT33 score, but the final iHOT33 score was only 43.9. The iHOT12 has equivalent responsiveness and validity as the iHOT33 [28]. In the present study, the mean iHOT12 score significantly improved from 44.0 to 73.5 in 4.7 months. Clearly, these two studies showed poor clinical outcome of physiotherapy for acetabular labral tear, which may be due to differences in the frequency of physiotherapy. Physiotherapy sessions per month was 3.3 ± 1.4 times in the present study, but Griffin et al. [12] reported between 6 and 10 rehabilitation sessions over 12–24 weeks. Furthermore, there is the possibility that the cause of hip pain was misunderstood, and there may have been differences in the overall concept of physiotherapy. In this study, all patients had acetabular labral tears. We established the therapy plan to improve joint stability and the clinical outcome of patients with acetabular labral tears. Our findings indicate that joint stability is important for the physiotherapy of acetabular labral tear. However, the clinical outcome of patients with Czerny III was significantly poor, and some of the patients with Czerny III had signs of microinstability. These findings indicate that Czerny III acetabular labral tear is a poor candidate for physiotherapy. In this study, 4 (40%) of 10 patients with Czerny III had positive signs in the microinstability tests. In an in vitro study, Smith et al. [6] measured the strain on the anterior and anterior-superior labrum when a compression load and anterior translation were applied to the acetabulum through the femoral head. There was no significant change in strain with a 1-cm circumferential tear of acetabular labral states compared to intact; however, the strain was significantly higher when there was a 2-cm circumferential tear. These findings suggest that the load on the acetabular labrum changes depending on the severity of the acetabular labral tear, and it may cause apprehension during the microinstability tests. In the present study, clinical outcomes significantly improved in patients with all bony deformity types. Although no study to date has examined the outcome of conservative therapy according to differences in bone morphology, we believe that bone morphology does not have a considerable effect on the outcome of physiotherapy.

Rankin et al. [15] reported that patients with hip joint pathology have high rates of coexisting extra-articular lesions. In the present study, 22 (63%) of 35 patients had extra-articular pathologies, and physiotherapy was performed according to the patients' symptoms. Kaya et al. [23] reported that extra-articular debridement could provide pain relief for the hip when it has not undergone labral repair. Careful attention to the external articular pathology may further improve physiotherapy outcomes for acetabular labral tear. Given that the pathogenesis of hip joint pain varies, it is important to determine the damaged tissue in relation to the symptoms and verify the effects of treatment.

In previous studies, 8% or 70% of patients who underwent conservative treatment eventually underwent arthroscopic surgery [12, 13], but the reasons were not considered. In this study, 8 (22.9%) out of 35 patients underwent surgical treatment after the failure of conservative therapy. Patients in the surgical group had poorer iHOT12 improvement and significantly lower post-intervention iHOT12 scores than did

patients in the non-surgical group. There was no difference in follow-up periods and physiotherapy sessions per month between the surgical group and the non-surgical group. Therefore, the duration and frequency of intervention may not affect the outcomes of physiotherapy. Four of eight patients in the surgical group had severe acetabular labral tears. In addition, some patients with severe acetabular labral tears had associated microinstability, which may be a limitation for conservative treatment and may thus be an indication for arthroscopic surgery. In the future, further studies are needed to examine these effects by increasing the number of patients with acetabular labral tears.

This study has a few limitations. The number of patients included in the present study was small, and the follow-up duration was short. A study with a larger number of patients is necessary to improve the accuracy of the results. For the evaluation of acetabular labral tear by MRI, Czerny classification was used. This evaluation method is originally a method performed in magnetic resonance arthrography (MRA). However, the 3T-MRI that we used is effective for visualizing acetabular labral tears [27], and there was no difference in the sensitivity of the evaluation of acetabular labral tears between 3T-MRI and 3T-MRA [29]. Therefore, we believe that the present study was able to target patients with true acetabular labral tears. To confirm the effectiveness of physiotherapy for acetabular labral tears, long-term observation of disease recurrence, deterioration of the acetabular labrum tear, and degenerative changes in the hip joint will be necessary. Because the present study was retrospective, we will develop it into a prospective study in the future.

Conclusions

In conclusion, physiotherapy significantly improved the iHOT12 score of patients with acetabular labral tears. However, patients with severe acetabular labral tears had poor symptom improvement with physiotherapy, and many such patients had to undergo surgery. Our findings support that the severity of acetabular labral tears is an important factor affecting treatment outcomes, and thus the identification of the severity of injury may be useful in determining appropriate treatment strategies.

Abbreviations

AIISpinitis: Anterior inferior iliac spinitis

FAI: Femoroacetabular impingement

iHOT12: International Hip Outcome Tool 12

LCEA: Lateral center-edge angle

MRA: Magnetic resonance arthrography

MRI: Magnetic resonance imaging

Declarations

Ethics approval and consent to participate

This study was approved by the Institutional Review Board of Sapporo Medical University Hospital. Informed consent was obtained from each participant, and the rights of the participants were protected.

Consent for publication

Not applicable

Availability of data and materials

The data that support the findings of this study are available from Makoto Kawai (mkt1031pc@yahoo.co.jp) upon reasonable request.

Competing interests

SN belongs to the endowed institutes of ZimmerBiomet and Smith & Nephew.

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Authors' contributions

All authors contributed to the study concept and design. M. Kawai takes responsibility for the integrity of the work as a whole, from inception to the finished article. M. Kawai, Y. Ikeda, and R. Motomura performed functional evaluations and physiotherapy for patients. K. Tateda, I. Kosukegawa, and M. Kaya performed the diagnosis and imaging evaluations. S. Nagoya advised and supervised the data analysis and helped to draft the manuscript. M. Katayose participated in the study coordination and helped to draft the manuscript. All authors read and approved the final submitted manuscript.

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Figures

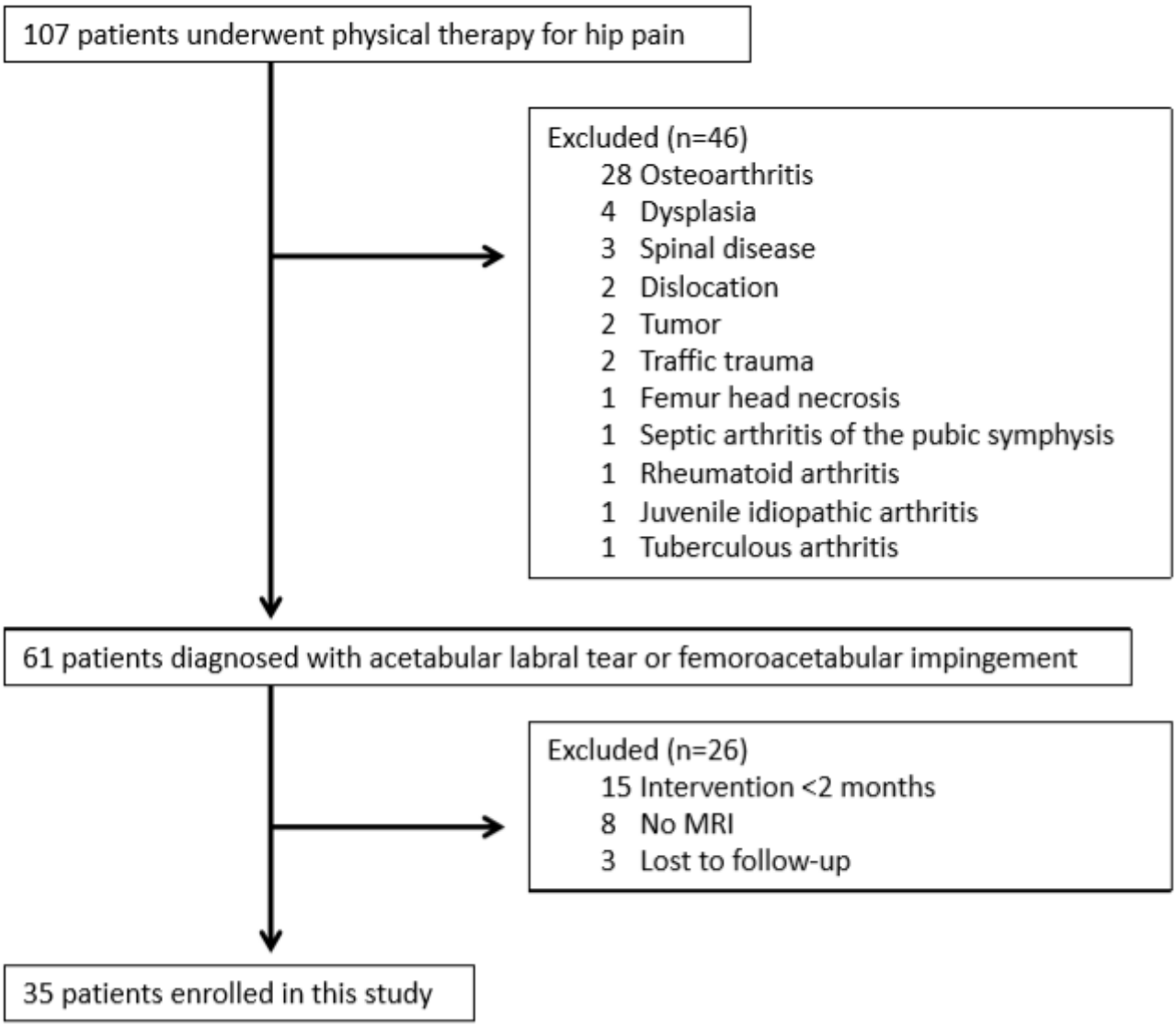


Figure 1

Flowchart of the recruitment of patients with acetabular labral tears or femoroacetabular impingement