REVIEW ARTICLE
Hip Pelvis 33(1): 3-10, 2021
https://doi.org/10.5371/hp.2021.33.1.3

Print ISSN 2287-3260
Online ISSN 2287-3279
Hip & Pelvis

Hip Arthroscopy for Sequelae of Legg-Calve-Perthes Disease: A Systematic Review

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There is no clear evidence on indications and outcomes of hip arthroscopy in sequelae of Legg-Calve-Perthes disease (LCPD). The aim of the current study was to evaluate current literature on the role and outcome of hip arthroscopy in LCPD. A literature search using four databases was conducted in April 2020, focusing on the role of hip arthroscopy in sequelae of LCPD. A systematic search was carried out in confirmation with the Cochrane Collaboration, Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines. A total of nine studies were included in the systematic review. The total number of hip arthroscopies performed for LCPD was 109. The mean age of included patients was 34.8±7.88 years (7-58 years). Recalcitrant hip pain was the main indication for surgery, followed by pain and stiffness. The most common finding in arthroscopy was labral tears, followed by osteochondral lesions of femoral head or acetabulum and intra-articular loose bodies. Consequently, debridement of labrum tears chondroplasty for cartilage defects and osteoplasty for impingement from deformed femoral head (hinged abduction) were commonly performed. A significant improvement in hip function was seen in all studies. Pooled data of Harris hip score showed significant improvement after surgery was conducted. Hip arthroscopy may be beneficial in patients having symptoms of impingement secondary to changes in labrum, femoral head or acetabulum. Limited evidence shows improved function and range of motion after surgery. This treatment has been found to be safe in terms of complication rates and improvement may persist for years.

Key Words: Hip arthroscopy, Legg-Calve-Perthes disease, Containment, Labral tears, Pediatric hip

INTRODUCTION

Legg-Calve-Perthes disease (LCPD) is a self-limiting avascular necrosis of the femoral head epiphysis in childhood. Simultaneous repair and resorption takes place leading to subsequent remodeling and deformation of the femoral head[1]. Conservative treatment typically suffices in children below six years of age and surgical containment may be necessary in older children. Once children start to recover with remodeling of the femoral head, symptoms in the hip joints may improve. Secondary changes like synovial hypertrophy, chondral changes in acetabulum and femoral head, labral tears, loose bodies and femoroacetabular impingement may develop over time[2]. Secondary changes may lead to pain and/or mechanical symptoms after a variable dura-

Submitted: August 7, 2020 1st revision: September 9, 2020
Final acceptance: September 9, 2020
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tion of time, which varies from a few to several years. The disease process can lead to osteoarthritis as age progresses[1]. In adolescents, total hip arthroplasty may not be an acceptable option for restoring hip joint function, consequently treatment of these sequelae aims to restore hip function and delay the need for total hip arthroplasty.

Hip arthroscopy has been frequently used in adults for treatment of femoroacetabular impingement and labral tears. There is a paucity of scientific evidence regarding the role of arthroscopy in LCPD. Several studies have shown that arthroscopy improves function in LCPD patients and has multiple advantages over open hip surgery including smaller incisions, a shorter recovery period, reduced damage to already damaged articular cartilage, and reduced risk of avascular necrosis of femoral head[3,4]. There is no synthesis of information in the form of a systematic review on indications and outcomes of hip arthroscopy in sequelae of LCPD, therefore the aim of the current study is to evaluate existing literature regarding the role and outcomes of hip arthroscopy in LCPD.

MATERIALS AND METHODS

A literature search using PubMed (http://www.ncbi.nlm.nih.gov/pubmed), Embase (http://www.elsevier.com/online-tools/embase), Google Scholar, and the Cochrane database (http://www.cochrane.org) was conducted on 15th April 2020 focusing on role of hip arthroscopy in sequelae LCPD. A systematic search was carried out in accordance with the Cochrane Collaboration, Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. The keywords used were 'Perthes disease', 'Legg-Calve-Perthes disease', and 'arthroscopy'. The search strategy used was [Perthes disease OR Legg-Calve-Perthes disease AND arthroscopy]. Various combinations along with the use of Boolean operators were used to maximize the search results. The search was replicated using the appropriate MeSH terms. The following filters were used to obtain the probable article candidates: humans, English and age (child and adolescent). Additional articles were identified using the 'related articles' feature. All bibliographies were checked for further probable studies for inclusion. Full text copies of reviewed papers were obtained after screening the title and abstract.

Studies on hip arthroscopy for sequelae of LCPD in children were included. Exclusion criteria were studies with less than two cases, open procedures, review articles, conference abstracts, conference papers, conference reviews, data papers, and editorials. Studies where LCPD was not the sole indication for hip arthroscopy were included, and the data on LCPD was extracted. Two authors reviewed the articles by titles and their abstracts. The full text was retrieved for the selected articles and further screened. After each review, the authors met to discuss any disagreement and decisions were made by consensus. Data from full-text copies was extracted in Microsoft Excel sheets. References of all the studies included were manually searched for any other eligible study. The PRISMA flowchart shows the review process at each stage (Fig. 1).

Pooled outcomes from the included studies were evaluated for meta-analysis. All studies included in the meta-analysis were reviewed for heterogeneity by comparing study designs, interventions, and outcomes. In addition, statistical tests of heterogeneity (I^2) were used. Statistical analysis was performed with Review Manager, vers. 5.3 (The Cochrane Collaboration, Copenhagen, Denmark). Analysis was performed using a random-effects model using the DerSemonian Laird method. Statistical significance was defined as a *P*-value of less than 0.05. Functional outcome scores used in the study were continuous outcomes and were expressed as means and 95% confidence interval.

RESULTS

1. Studies and Samples

The total number of abstracts screened initially was 163 (Fig. 1), and a total of 9 studies were included in the systematic review. The total number of hip arthroscopies performed for LCPD was 109. The mean age of included patients was 34.8±7.88 years (7-58 years). Details of the studies included are presented in Table 1. In four of the included studies LCPD was not the only indication for hip arthroscopy[5-8]. These studies combined different etiologies for which hip arthroscopy was performed in adolescents, therefore data on hip arthroscopy for LCPD was extracted from these studies. All included articles were retrospective studies, and none had any control group for comparison.

2. Indications

Recalcitrant hip pain (70/80, 87.5%) was the main indication for surgery in the studies reviewed[5,7-11]. Mechanical symptoms (56/75, 74.6%) followed pain as the indication of surgery[2,8,9]. Restriction of motion at the hip joint (17/64, 26.5%) was the next most common indication for surgery[2,8,9,12].

Preoperative magnetic resonance imaging (MRI) findings were reported in 4 studies[2,7,8,10]. The common MRI findings considered as indications for hip arthroscopy were presence of an osteochondral defect in the femoral head, loose body inside the hip joint, and labral tears.

3. Intraoperative Findings and Operative Procedures

Intraoperative findings and surgical procedures carried out are summarized in Table 2. The most common finding at the time of hip arthroscopy was labral tears, seen in 56/70 patients; followed by osteochondral lesions of the femoral head or acetabulum, seen in 55/70 patients; and intra-articular loose bodies from detached osteochondral lesions, seen in 21/70 patients. Consequently, debridement of the labrum tears, chondroplasty for cartilage defects, and osteoplasty for impingement from the deformed femoral head (hinged abduction) were commonly performed procedures.

4. Functional Outcomes

A significant improvement in hip function was seen in all the studies[2,5,7-12]. The Harris hip score (HHS) was available in four studies[2,5,9,11], the results of which were pooled (Fig. 2). Meta-analysis was performed comparing the preoperative and postoperative HHS using a random effect model (I^2=90%). Harris hip scores were significantly better post-operatively (z=21.30, P< 0.001). Six studies reported a significant improvement in the range of motion of hip joint at the final follow-up[7-9,11-13].

Pain scores before and after the surgery were reported in a single study[11]. Significant reduction in pain scores was seen at final follow-up. Stiffness was an important indication for surgery. Hip range of motion was documented in two studies[11,12], with significant improvement in hip range of motion, particularly abduction and external rotation. Data could not be pooled for further analysis as it was not reported in its entirety.

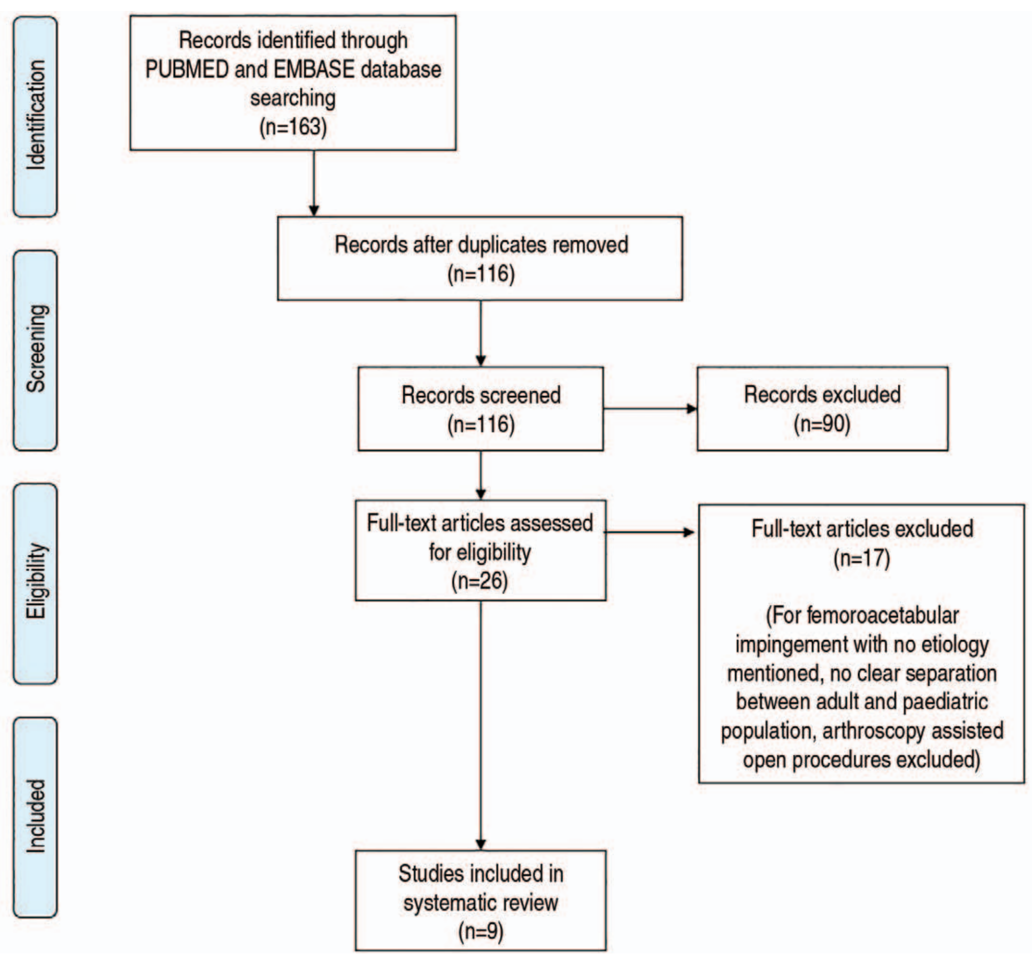

Fig. 1. Depiction of study inclusion and exclusion criteria using Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flowchart.

Table 1. Details of Various Studies with Demographic Details and Outcomes Included

Name of study	Type of study	Sample size	Age (yr)	Sex	Follow-up (mo) - details, if any	ROM (°)		Harris hip score		Preoperative symptoms/ indication of surgery	Postoperative protocol
						Preoperative	Postoperative	Preoperative	Postoperative		
Freeman et al.[9] (2013)	Retro spective - IV	23 (bilateral: 1)	27.7 (7-58)	Male: 14, female: 8	42 (24-180)			56.5±12.7 (31-80)	85±12.5 (61-100)	Hip pain; Low bachache; standing pain; restricted ROM; locking episode; giving way/ loose bodies; labral tear; cartilage lesion	Crutches for 1 wk; restricted weight bearing for 2 mo; full activity 2 mo
Majewski et al.[12] (2010)	Retro spective - IV	11	13 (8-17)	Male: 8, female: 3	24 (12-48)	Flexion: 100; external rotation: 15; abduction: 5	Flexion: 120; external rotation: 30; abduction: 20			Loss of motion	Passive ROM: 5 day; plaster splints: 2 hr/day for 3 mo; ambulation after 2 wk
Kocher et al.[5] (2005)	Retro spective - IV	8						49.5±7.7	80.1±7.9	Hip pain	
Roy[10] (2005)	Retro spective - IV	9	15 (12.3 -16.6)	Male: 5, female: 4	Minimum: 24 mo; symptom: improvement: 7; revision hip scopy (labral tear/ ligamentum teres tear): 2; THR: 1 (at 3 yr)					Hip pain/ recalcitrant hip pain	Crutches for 1 wk; restricted weight bearing for 2 mo; full activity 2 mo
Nwachukwu et al.[6] (2011)	Retro spective - IV	10									

(Continued to the next page)

Table 1. Continued

Name of study	Type of study	Sample size	Age (yr)	Sex	Follow-up (mo) - details, if any	ROM (°)		Harris hip score		Preoperative symptoms/ indication of surgery	Postoperative protocol
						Preoperative	Postoperative	Preoperative	Postoperative		
Kanatli et al.[2] (2019)	Retrospective - IV	10	12.7 (7-16)		55.4 (42-72)			43.3±8.17 (32-54)	89.1±6.43 (76-95)	Reduced walking distance; difficulty in sitting; reduced ROM/failed conservative methods and MRI findings of osteochondral fragment	Partial weight bearing: 4 wk; strenuous exercises after 6 wk
O'leary et al.[8] (2001)	Retrospective - IV	9	20.78		13					Hip pain 100%; restricted ROM 67%, mechanical symptoms 100%/ loose body and loose osteochondral lesion	
Lee et al.[11] (2018)	Retrospective - IV	23	35 (16-49)	Male: 14, female: 9	Minimum: 24 mo	Flexion: 88.7; external rotation: 20.4	Flexion: 106.5; external rotation: 33.5	62.6±7.5 (44-73.7)	87.4±5.2 (75.9-96.8)	Hip pain	Active and passive ROM: immediately postoperative; toe touch weight bearing: 2 wk, 6-8 wk in microfracture patients
Lim et al.[7] (2020)	Retrospective - IV	6	15.2 (12.3-17.9)		62 (27-90)					Hip pain	Passive ROM: day 2; partial weight bearing: 6 wk

ROM: range of motion, MRI: magnetic resonance imaging, THR: total hip arthroplasty.

Table 2. Details of Intraoperative Findings and Operative Procedures Done in Various Studies Included

Name of study	Intraoperative finding	Surgical procedure
Freeman et al.[9] (2013)	Labral tears: 18; torn ligamentum teres: 17; femoral chondral lesion: 9; acetabular chondral lesion: 8; loose bodies: 3; osteochondral defect: 3; cam lesion: 2	Loose body excision; debridement of labral tear; synovium resection; chondroplasty; osetoplasty; ligamentum teres debridement; microfracture; osteophyte excision
Majewski et al.[12] (2010)		Arthroscopic hydraulic mobilisation
Roy[10] (2005)	Labral tears: 2; torn ligamentum teres: 4; femoral chondral lesion: 2; acetabular chondral lesion: 2; osteochondral defect: 4; synovitis: 1	Debridement of labral tear: 3; synovium resection: 2; chondroplasty: 6; ligamentum teres debridement: 4
Nwachukwu et al.[6] (2011)		Chondroplasty; microfracture; labral debridement
Kanatli et al.[2] (2019)	Synovial hypertrophy; unstable osteochondral fragment; ligamentum teres tear	Arthroscopic osteochondral fragment debridement; microfracture
O'leary et al.[8] (2001)	Synovitis: 4; labral tear: 8; loose body: 2; degenerative joint: 2; chondral lesion: 9	Loose body removal, chondral debridement
Lee et al.[11] (2018)	Labral tears: 23; loose bodies: 16; osteochondral lesions: 16; ligamentum teres tear: 3	Osteoplasty: 23; labral resection: 17; loose body excision: 16; microfractures: 16; labral repair: 6; ligamentum teres debridement: 3
Lim et al.[7] (2020)	Cam lesion: 6; labral tear: 5; ligamentum teres tear: 4; Osteochondritis dessicans: 2	Osteochondroplasty; ligamentum teres debridement; labral debridement; loose body excision

Data regarding the number of individual findings and operations, wherever mentioned, have been denoted.

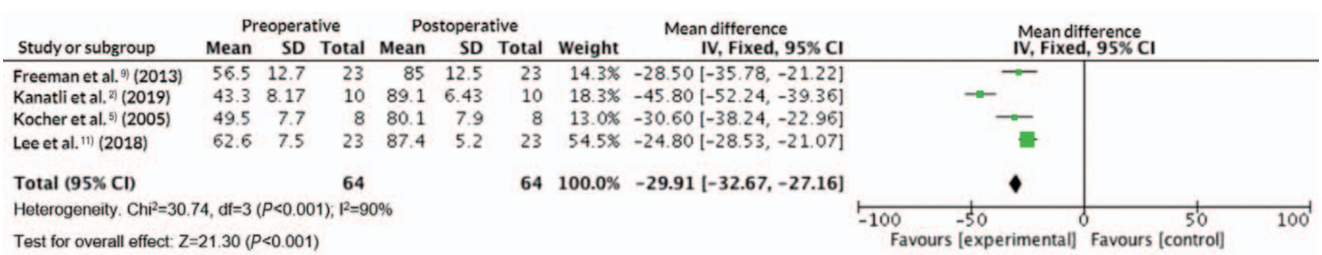

Fig. 2. Forest plot of pooled results of differences between pre- and postoperative Harris hip scores.
SD: standard deviation, CI: confidence interval, df: degree of freedom.

5. Complications

Six studies did not report any complication at final follow-up[2,3,8-11]. Two studies reported complications following arthroscopy at final follow-up[6,7]. Suture abscess at the proximal portal site and transient numbness in the groin area due to compression of pudendal nerve were noted, however these resolved without the need for any intervention.

DISCUSSION

Findings of this review provided limited evidence in favor of arthroscopic treatment for mechanical symptoms from sequelae of LCPD. Evidence in favor of arthroscopic treatment for pain was weak. There was no evidence to suggest deterioration of function or major complications after the procedure, which appears to be relatively safe.

Sequelae of LCPD may result in mechanical impingement in the hip joint[13,14]. Lesions commonly included cartilage fragments, loose osteochondral bodies, labral tears, tears of ligamentum teres and synovitis. Hip arthroscopy had been attempted for such sequelae after the remodeling stage of the disease. Limited evidence suggested that hip arthroscopy for addressing impinging lesions and mechanical symptoms may be beneficial in the early stages of LCPD[2].

Deformation of the femoral head, lateralization and mineralization lateral to the normal confines of the femoral epiphysis led to impingement of the head against the edge of the acetabulum[10]. This phenomenon is known as hinged abduction which leads to reduced abduction of the hip joint. Edge loading against the acetabulum leads to labral damage and erosion of the cartilage. The osteonecrotic fragments of the femoral head epiphysis may fragment and separate, resulting in loose osteochondral fragments which are frequently seen in the central portion of the femoral head close to the attachment of ligament teres. Hip arthroscopy may benefit selected patients having impingement, and management of bony and labral lesions can result in symptomatic improvement. Loose osteochondral fragments, impinging cam lesions, and labral tears can be diagnosed on MRI, making it the investigation of choice to identify patients who would benefit from hip arthroscopy[2,7,8,10]. Notably, MRI is less sensitive in comparison to arthroscopy for detection of labral tears.

Freeman et al.[9] described the following interventions during arthroscopy: loose body removal, labral debridement, synovectomy, chondroplasty, osteoplasty, debridement of hypertrophic ligamentum teres and microfracture for chondral defects. Similar procedures were described by Lee et al.[11] after debridement, when residual impingement can be judged with dynamic hip motion under arthroscopic guidance[11]. Roy[10] suggested that standard portals may have to be modified to accommodate for trochanteric overgrowth, coxa-magna and changes in the acetabulum.

Arthroscopic treatment is not aimed at restoring sphericity of the femoral head, and it is not known whether this could save it from progression of degenerative changes in the future. Kanatli et al.[2] had a mean follow-up of 55 months for patients who underwent a hip arthroscopy with preservation of function of the hip joint[2]. O'leary et al.[8] reported that eight of the nine patients who underwent hip arthroscopy were asymptomatic at 30 months. Most studies reviewed focused on osteochondroplasty, debridement of labral and synovial tissue and loose body removal to achieve range of motion in the hip joint. Majewski et al.[12] used distension of the hip joint during hip arthroscopy along with osteoplasty of the impinging femoral cam lesion[12], resulting in good outcomes in terms of range of motion[12].

Normal anatomy of the hip joint is altered in LCPD which may not be restricted to the femoral head. Trochanteric overgrowth and changes in the acetabulum are seen over time and may require a change in position of portals for hip arthroscopy[10] or an open procedure.

Post-operative rehabilitation focusing on mobilization of the hip joint is important to achieve and maintain range of motion[2,12]. No significant complications have been seen in arthroscopic treatment in children and adolescents[5]. Transient pudendal nerve hypoaesthesia was the most frequently seen complication, but it did not require any specific treatment.

LIMITATIONS

Though this review provides new insight into the arthroscopic treatment of sequelae of LCPD, the strength of this systematic review is limited by the quality of the studies included. All included studies were retrospective and non-comparative in nature and included a small number of patients. The included studies were heterogeneous in terms of quality and methodology, as were methods of outcome assessment. Follow-up data was limited and no major conclusion could be drawn regarding survivorship in terms of need for arthroplasty in future. Though patients had been carefully selected in the studies for this treatment, inclusion criteria were not adequately defined.

CONCLUSION

Hip arthroscopy for sequelae of LCPD may be beneficial in patients having symptoms of impingement secondary to changes in the labrum, femoral head or acetabulum. Limited evidence shows improved function and range of motion after surgery. This treatment has been found to be safe in terms of complication rates and improvement may persist over several years.

CONFLICT OF INTEREST

The authors declare that there is no potential conflict of interest relevant to this article.

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