Systematic Review

Arthroscopic Management of Hip Chondral Defects: A Systematic Review of the Literature

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Purpose: To critically evaluate the evidence for arthroscopic management of chondral defects in the hip through a systematic literature review. **Methods:** A systematic literature review was performed to identify all articles addressing the arthroscopic management of chondral defects about the hip. Case reports, open techniques, and those associated with osteonecrosis were excluded. Articles were assessed for sample size, location, severity, and size of chondral defects, and the surgical technique. Associated injuries, follow-up duration (months), and functional outcomes were recorded. Study cohorts were defined by a surgical technique (debridement *v* microfracture *v* autologous chondrocyte transplantation [ACT]). Statistical analysis was performed with a χ^2 test and analysis of variance with post hoc pairwise analysis for categorical and continuous data, respectively, with significance defined as $P < .05$. **Results:** The literature search identified 269 articles, of which 12 clinical studies met inclusion criteria for this analysis. After pooling the data, there were 579 (64.7%) debridements, 279 (31.2%) microfracture, and 37 (4.1%) ACT performed. Patients were followed for an average of 27.1 months (range: 5 to 72 months). All lesions treated with either a microfracture or ACT were high grade (Outerbridge 3 to 4). However, lesion size was significantly larger in ACT-treated patients compared with those who underwent microfracture (357.3 ± 96.0 mm^2 *v* 149.5 ± 20.7 mm^2; $P = .020$). All cohorts showed significant improvement in functional outcomes after hip arthroscopy ($P < .001$). **Conclusions:** This systematic review showed that arthroscopic debridement, microfracture, and ACT are associated with equivalent improvement in clinical outcomes in patients with high-grade chondral defects in the hip in the short- and midterm follow-up. In addition, although there were no differences in patient characteristics and demographics based on the surgical technique, we confirmed the hypothesis that lesion size varied significantly between arthroscopic techniques, and that the decision to use one technique over another may be determined by the size of the defect. Therefore, lesion size is likely to influence the development of hip- and technique-specific indications, and may also represent a useful metric for success of surgical intervention. **Level of Evidence:** Level IV, systematic review of Level III and IV studies.

Arthroscopic hip preservation techniques are rapidly evolving, but limited data support best practices in arthroscopic management of chondral hip injuries. Hip chondral injuries can be acute or chronic, involve a full or partial thickness lesion, and may represent a significant source of joint pain.[1] Chondral defects have limited healing capacity and have been associated with worse outcomes in patients undergoing hip arthroscopy.[2-4] For this reason, there is increasing interest in developing safe and effective, minimally invasive, biologic, arthroscopic techniques to improve outcomes in patients with chondral defects in the hip.

Many of the arthroscopic techniques used to treat chondral defects in the hip were adapted from techniques used to treat chondral defects in the knee; these techniques include microfracture, autologous osteochondral transplantation, osteochondral allograft transplantation, and autologous chondrocyte implantation with the use of tissue engineered scaffolds.[5-9]

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However, the anatomy and biomechanics of the hip and knee joints are inherently different, which may require an individualized approach specific to each joint.[10] Regardless of that, hip joint degeneration can cause great dysfunction and pain. Surgical techniques aimed at delaying disease progression in young, active patients may obviate the need for arthroplasty in this population, allowing for continued active lifestyles.

Chondral defects in the hip are effectively treated with both open[11-18] and arthroscopic techniques.[19-28] Hip arthroscopy offers several advantages over open techniques, including improved visualization of chondral defects and associated pathologies (such as labral tears, femoroacetabular impingement, ligamentum teres derangement, and removal of loose bodies), less soft tissue trauma and a faster recovery.[21]

Current arthroscopic techniques used to treat chondral defects in the hip include microfracture,[19,22,23,25-28] autologous chondrocyte transplantation (ACT),[20,21,24] fibrin adhesive,[29,30] and retrograde osteochondral autologous transplantation.[31] Indications vary between each of these procedures, but include full-thickness loss of articular cartilage in either a weight-bearing area or in an area of contact between the femoral head and acetabulum, or an unstable cartilage flap with intact subchondral bone.[23] Despite the unique challenges associated with the management of chondral defects in the hip, current surgical techniques and their indications have been influenced from the knee literature and are not hip joint-specific. To address this knowledge gap, a systematic literature review was performed to evaluate the current evidence for arthroscopic management of chondral defects in the hip. We hypothesized that there would be a significant difference in patient- and lesion-specific characteristics between chondral defects treated with arthroscopic debridement, microfracture, and ACT.

Methods

A systematic review of the literature was conducted using a combination of free text and Medical Subject Headings terms (Table 1) to identify all relevant articles related to the arthroscopic management of hip chondral lesions. The following databases were searched: Medline, CINAHL, Cochrane, and Pubmed. Reference tracking was performed for any articles potentially missed throughout the search. The literature search was conducted on 2 separate occasions (March 5, 2015, and April 2, 2015) independently by 2 of the authors (S.M. and A.M-L.) after recommendations from the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines.[32] Case reports, open techniques, non-English manuscripts, and those associated with osteonecrosis were excluded. Other literature reviews were also excluded (Fig 1). Records were stored in a computer-based referenced management system (EndNote, Thomson Reuters, New York, NY).

The selected studies were reviewed to specifically assess sample size, patient demographics, lesion location, Outerbridge severity grades, and size of chondral defects, as well as the surgical technique for repair. Associated injuries, follow-up time (months), and outcome measures were recorded. If stated in the study, the time to total hip arthroplasty (THA) or hip resurfacing was also analyzed.

Given the small sample size in each study, individual patients were grouped based on the type of procedure (microfracture *v* ACT *v* debridement). Data for the debridement cohort were taken from studies that reported outcomes from patients who underwent debridement without microfracture or ACT. All cohorts were compared with regard to demographics, lesion size (mm^2), follow-up time, outcome measures (Harris hip score [HHS], modified HHS [mHHS], and nonarthritic hip score [NAHS]), and time to THA or hip resurfacing. HHS and mHHS were averaged together to compare outcomes between groups. Statistical analysis was performed using SPSSv.20 (IBM, Chicago, IL) with a χ^2 test and analysis of variance with post hoc pairwise analysis for categorical and continuous data, respectively. An alpha-level of less than 0.05 was used to denote statistical significance between groups.

Results

Patient Demographics and Arthroscopic Techniques

A total of 5 case series and 7 retrospective studies (4 cohort studies and 3 case controls) addressing the arthroscopic management of chondral defects in the hip met our inclusion criteria (Table 2). Seven were Level III studies and 5 were Level IV studies. A total of 895 patients comprised the total population in this analysis, of whom 279 (31.2%) underwent microfracture, 37 (4.1%) ACT, and 579 (64.7%) only required thermal and/or debridement chondroplasty (Table 3). The

Table 1. List of Terms Used for Database Search

- MeSH terms
  - Hip
  - Arthroscopy
  - Arthroscopic subchondral microfracture
- Free text search (various combinations)
  - Hip
  - Arthroscopy
  - Arthroscopic repair
  - Chondral defects
  - Chondral injuries
  - Chondral lesions
  - Microfracture
  - Delaminated articular cartilage
  - Mosaicplasty

MeSH, Medical Subject Headings.

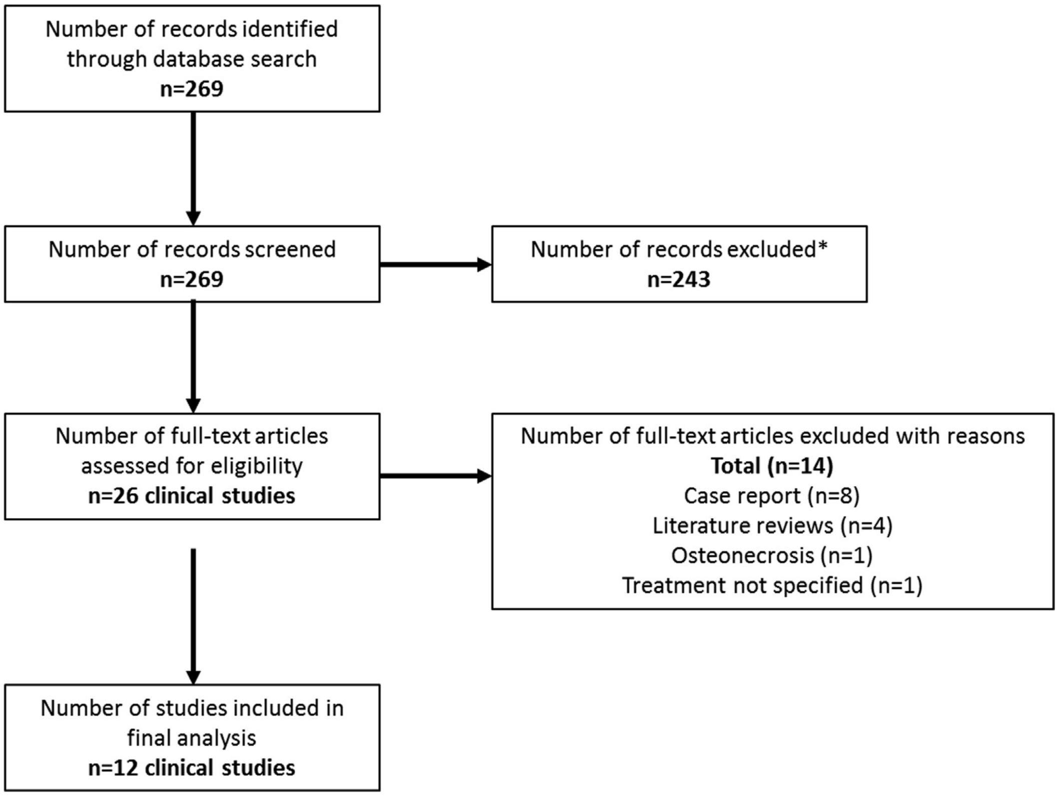

Fig 1. Flowchart of systematic database review. *Knee arthroscopy, arthrotomy, non-English papers, unrelated, animal studies.

average age was 36.6 years (range: 14 to 78 years) and the majority were male (67.1% [40% to 87.5%]). Nine studies reported the use of microfracture techniques to correct high-grade (Outerbridge 3 to 4) chondral defects, whereas 3 studies reported the use of ACT. In addition, 4 studies also reported outcomes on patients who underwent arthroscopic debridement for low- to high-grade chondral lesions (Outerbridge 1 to 4). All studies reported associated lesions that required treatment at the time of arthroscopic exploration including labral tear repair, osteoplasty for femoroacetabular impingement (FAI), ligamentum teres repair or resection, loose body removal, and capsular repair.

Postoperative Outcomes

On average, patients were followed up 27.1 months (range: 5 to 72 months); however, follow-up time varied significantly between studies (P = .002) (Table 3).

Elite Athletes

Two of the 3 studies performed on elite athletes reported follow-up with regard to active seasons played after surgical intervention (mean: 3 seasons; range 1 to 11 seasons). One study was on Australian football players, 1 on hockey players, and 1 on professional athletes from different sports (football, soccer, hockey, golf, baseball, and tennis). Patient age ranged from 16 to 37 years, and average lesion size was only specified in 2 of the 3 studies (119 and 162 mm^2). On average 77% to 95.8% of the patients returned to their pre-injury level of play the current season or the season after injury.

Second Look Arthroscopy

Three studies reported second look arthroscopy in 39 of 323 patients (12.1%) due to continued pain and discomfort, catching sensation, and limited range of motion after microfracture (Table 3). Second look arthroscopy procedures treated FAI, labral tears, cam lesions, and capsular adhesions. At an average 20-month follow-up, of the 29 patients with available data, 2 (6.9%) had 25% fill, 6 (20.7%) had 75% to 95% fill, and 21 (72.4%) had 100% fill. Of these, all showed good repair quality on inspection (Blevins grade 1). Biopsies on a limited number of patients (n = 2) reported primarily fibrocartilage with randomly arranged collagen fiber bundles throughout the extracellular matrix. In 1 sample, there was a small area near to the bone where the matrix resembled hyaline

Table 2. Patient Characteristics and Surgical Techniques

Study	Year Published	Design	No. of Patients	Mean Age (age range)	BMI	Gender, % male (male/female, n)	Duration of Symptoms	Anatomic Region	Chondral Defect Grade	Lesion Size	Procedure	Associated Lesions
Philippon et al.[28]	2008	Case series	9	37.2 (21-47)	NA	55.6 (5/9)	NA	Acetabulum (superior quadrant)	Outer bridge 4	163 mm^2 (40-240 mm^2)	Microfracture	LT FAI, CR
Philippon et al.[27]	2009	Retrospective cohort	112	40.6 (95% CI, 37-44)	24 (95% CI, 23.2-25)	44.6 (50/112)	34 mo (25.2-42.8 mo)	Acetabulum (n = 30, zone NA) FH (n = 8) A+FH (n = 9)	Outer bridge 4	Not specified	Microfracture (n = 47)‖	LT, FAI, Lt, LB, synovitis
Byrd et al.[33]	2009	Retrospective cohort	200	34 (20-43)	NA	69 (138/200)	32 mo	Acetabulum and FH (number and zone NA)	Outerbridge 4	Not specified	Microfracture (n = 58)‖	LT, FAI
Haviv et al.[22]	2010	Retrospective cohort	166	37 (14-78)	NA	79.5 (132/166)	12 wk	Acetabulum (anterolateral)	Outerbridge 3-4	Not specified (<300 mm^2)	Microfracture (n = 29)‖	LT, FAI
Singh et al.[36]*	2010	Retrospective cohort	24	22 (16-29)	24 (21-26)	100	6 wk to 32 mo	Acetabulum (chondro-labral junction)	Not specified	Not specified (<300 mm^2)	Microfracture (n = 6)‖	LT, LB, FAI, synovitis
Fontana et al.[21]	2012	Retrospective case-control	15†	40.7 (22-52)	NA	40 (6/15)	NA	Acetabulum (n = 15, ant+sup) A+FH (n = 3)	Outerbridge 3-4	2.6 cm^2 (2-3.4 cm^2)	ACT (polymer scaffold)	Not mentioned
Karthikeyan et al.[23]	2012	Case series	20	37 (17-54)	NA	80 (16/20)	NA	Acetabulum (n = 20)	Not specified	154 mm^2 (50-300 mm^2)	Microfracture	LT, FAI, Lt
McDonald et al.[26]*	2014	Case series	17	31 (23-37)	NA	100	NA	Acetabulum and/or femoral head (number and zone NA)	Outerbridge 4	119 mm^2 (20-250 mm^2)	Microfracture	LT, FAI
Fickert et al.[20]	2014	Case series	6	33 (25-45)	26 (20-31)	83.3 (5/6)	NA	Acetabulum (n = 5, anterolateral and anteromedial) FH (n = 1)	ICRS IIIa-IIb	3.6 cm^2 (1.8-6 cm^2)	ACT 3D	LT, FAI
McDonald et al.[25]*	2013	Retrospective case-control	39‡	30.3	NA	100	NA	Acetabulum (n = 30, zone NA) FH (n = 5) A+FH (n = 4)	Outerbridge 4	162 mm^2 (20-378 mm^2)	Microfracture	LT, FAI, Lt, LB, CR
Korsmeier et al.[24]	2014	Case series	16	31.8 (20-47)	NA	87.5 (14/16)	NA	Acetabulum (n = 16, zone NA)	Outerbridge 3-4	4.52 cm^2 (3-6 cm^2)	ACT 3D	LT, FAI
Domb et al.[19]	2015	Retrospective case-control	54§	47 (26-68)	NA	65	NA	Acetabulum (n = 49, zone NA) FH (n = 5)	Outerbridge 4	Not specified	Microfracture	LT, FAI, Lt, LB, CR, IP

ACT, autologous chondrocyte transplantation; BMI, body mass index; CI, confidence interval; CR, capsular repair; FAI, femoroacetabular impingement (CAM or pincer); FH, femoral head; ICRS, International Cartilage Repair Society; IP, iliopsoas release; LB, loose bodies; LT, labral tear repair; Lt, ligamenturm teres repair; NA, not available.

*Cohort consisted of elite athletes.

†Matched control (n=15) underwent debridement with no microfracture (Outerbridge 3-4, size <2 cm^2).

‡Control (n = 81) underwent hip arthroscopy with no microfracture (Outerbridge $\leq$ 3).

§Control (n = 108) underwent hip arthroscopy with no microfracture (Outerbridge $\leq$ 3).

‖The rest of the patients underwent thermal and/or debridement chondroplasty (Outerbridge 2-4). No clear difference in indication between microfracture and debridement.

Table 3. Patient Outcomes After Arthroscopic Treatment for Chondral Defects in the Hip

Study	Level of Evidence	Procedure	Mean Follow-up (range)*	Outcomes Measurements Preop†	Outcomes Measurements Postop†	Arthroplasty	Other Findings
Philippon et al.[28]	IV	Microfracture	20 mo (10-36 mo)	–	% fill: 91% (25-100)	22.2% (2/9) 10 mo-5.5 yr	Only 1 patient had 25% fill (OA of femoral head)
Philippon et al.[27‡]	III	Microfracture	27.6 mo (24-34.8 mo)	mHHS: 58 HOS-ADL: 70 HOS-sport: 43 NAHS: 66	mHHS: 84.3 HOS-ADL: 87.8 HOS-sport: 69 NAHS: 81	8.9% (10/112) 16 mo	Joint space <2 mm had a greater risk of THA (RR: 39 (95% CI, 5.5-263) THA patients were on average 18 yr older (95% CI, 8-28) at the time of arthroscopy (58 *v* 39, $P < .001$)
Byrd et al.[33]	IV	Microfracture	16 mo (12-24 mo)	HHS: 65	HHS: 85	0.5% (1/200) 8 mo	One patient with diffuse grade 4 chondral lesion underwent THA 8 mo after index arthroscopy. Unclear if this patient had undergone microfracture
Haviv et al.[22]	III	Microfracture	22 mo (12-72 mo)	mHHS: 72.7 NAHS: 70.0	mHHS: 87.5 NAHS: 90.2	6.9% (2/29) 13-18 mo	10/29 patients who underwent microfracture required repeat procedure for continued symptoms Microfracture group showed greater improvement in NAHS compared with no microfracture (+20.2 *v* +13.2)
Singh et al.[36‡§]	IV	Microfracture	22 mo (6-60 mo)	–	95.8% returned to play	NA	23/24 players resumed full training within 3 mo‡
Fontana et al.[21]	III	ACT	72 mo (72-76 mo)	HHS: 48.3	HHS: 87.4	NA	Greater postoperative HHS scores compared with debridement group (87.4 *v* 56.3)
Karthikeyan et al.[23]	IV	Microfracture	21 mo (5-48 mo)	NAHS: 55	NAHS: 78	NA	% fill: 93 (25-100). Cartilage was normal appearing, with borders difficult to discern (Blevin grade 1)
McDonald et al.[26§]	III	Microfracture	(1-5 seasons)	–	82% returned to play	NA	
Fickert et al.[20]	IV	ACT 3D	11.2 mo	mHHS: 74.5 NAHS: 67.5 Phys SF-36: 47.8	mHHS: 98.0 NAHS: 95.6 PhysSF-36: 93.4	NA	
McDonald et al.[25§]	III	Microfracture	3 seasons (1-11 seasons)	–	77% returned to play	NA	84% with no microfracture returned to play
Korsmeier et al.[24]	III	ACT 3D	16.1 mo (9.5-28.8 mo)	NAHS: 45 WOMAC: 57	NAHS: 71 WOMAC: 90	NA	
Domb et al.[19]	III	Microfracture	25.6 mo (17.3-48.9 mo)	mHHS: 56.6 NAHS: 52.3 HOS-ADL: 58.4 HOS-SSS: 34.8 VAS: 5.7	mHHS: 74.2 NAHS: 71.2 HOS-ADL:74.2 HOS-SSS: 57.7 VAS: 4.0	NA	Both microfracture and no microfracture group showed significant improvement between pre- and postop scores. No significant differences between the 2 groups

ACT, autologous chondrocyte transplantation; ADL, activities of daily living; CI, confidence interval; HHS, Harris hip score; HOS, hip outcome score; mHHS, modified HHS; NA, not available; NAHS, nonarthritic hip score; OA, osteoarthritis; RR, relative risk; SF, short form; SSS, sports-specific subscale; THA, total hip arthroplasty; VAS, visual analog scale; WOMAC, Western Ontario and McMaster Universities Arthritis Index.

*Follow-up time was significantly different between studies ($P = .002$).

†Pre- and postop scores are for either the microfracture or ACT groups. Scores for control groups are not listed.

‡Data not specific to microfracture cohort or not clarified (data not included in analysis of variance analysis between technique cohorts).

§Cohort consisted of elite athletes.

cartilage with its typical glass-like appearance when viewed with polarized light.

Total Hip Arthroplasty Rates

The rate of total hip arthroplasty (THA) or resurfacing ranged from 0.5% to 8.9% and was performed 8 to 18 months after index arthroscopy. Only 4 studies, with a mean follow-up of 16 to 27.6 months, reported THA rates (Table 3). Although in most studies patients with radiographic evidence of severe arthritis (e.g., Tonnis grade 3 or joint space <2 mm) were excluded, other studies showed that progression to THA was associated with diffuse osteoarthritis, joint space <2 mm or extensive Outerbridge grade 4 lesions at the time of index arthroscopy. No ACT studies reported rates of THA.

Comparative Analysis Between Arthroscopic Techniques

Studies reporting on patients treated by microfracture, ACT, or debridement were compared with assess differences in study design, demographics, and surgical outcomes (Table 4). There were no significant differences in the sample size, mean age, gender, or follow-up time between studies. On average, lesion size was significantly larger in ACT-treated patients compared with those who underwent microfracture (357.3 ± 96.0; range: 180 to 600 mm^2 *v* 149.5 ± 20.7 mm^2; range: 20 to 378; *P* = .020). In addition, all but 3 studies, reported pre- and postoperative NAHS, and/or either HHS or mHHS. Overall, patients showed a significant improvement in all outcome measures compared with preoperative scores (*P* < .001) (Table 4). However, the differences between pre- and postoperative NAHS (*P* = .103) and HHS/mHHS (*P* = .128) after 22.0 ± 4.1 to 41.2 ± 28.8 months of follow-up did not significantly differ between the 3 cohorts.

Table 4. Microfracture Versus ACT Versus Debridement for Arthroscopic Management of Chondral Defects

	Microfracture	ACT	Debridement	*P* Value
Number of studies	9	3	4	
Number of patients	31.0 ± 19.4	12.3 ± 5.5	81.2 ± 46.0	.008*,†
Mean age	35.1 ± 7.0	35.2 ± 4.8	39.1 ± 6.9	.559
% male	77.0 ± 20.4	70.3 ± 26.3	65.8 ± 24.9	.667
Lesion size, mm^2	149.5 ± 20.7	357.3 ± 96.0	260 ± 0.0	.020*,‡
Follow-up time, mo	22.2 ± 3.9	33.1 ± 33.8	37.8 ± 24.5	.430
HHS (n)	(4)	(2)	(3)	
Preop	63.1 ± 7.4	61.4 ± 18.5	58.5 ± 9.8	.831
Postop	82.8 ± 5.9	92.7 ± 7.5	75.8 ± 13.1	.205
Avg difference§	19.7 ± 4.9	31.3 ± 11.0	17.2 ± 7.1	.128
NAHS (n)	(4)	(2)	(2)	
Preop	60.8 ± 8.5	56.3 ± 15.9	62.7 ± 7.2	.776
Postop	80.1 ± 7.9	83.3 ± 17.4	79.4 ± 2.7	.889
Avg difference	19.3 ± 3.3	27.1 ± 1.5	17.6 ± 6.2	.103

NOTE. Values expressed in mean ± standard deviation, unless indicated otherwise.

ACT, autologous chondrocyte transplantation; HHS, Harris hip score; NAHS, nonarthritic hip score.

*Statistically significant.

†Post hoc analysis (Bonferroni) showed significant differences between debridement group and both microfracture and ACT (*P* < .05).

‡Lesion size for debridement groups was only reported in a single study. No post hoc analysis performed.

§All postop scores significantly improved compared with preop scores (*P* < .001).

Discussion

The data from this systematic review showed that, although average defect size was greater in ACT-treated patients (357.3 ± 96.0 mm^2) compared with microfracture (149.5 ± 20.7 mm^2), short- to midterm outcome measures did not significantly differ between intervention groups (Table 4). Similarly, in the case series (n = 6) reported by Fickert et al.,[20] defect size did not prove to have a major influence on overall postoperative outcome after ACT (1.8 to 6 cm^2). Unfortunately, most studies in this review did not specifically attempt to correlate defect size with postoperative outcome, and as a result the impact of chondral defect size on functional outcomes after hip arthroscopy is still not fully understood. However, defect size may play a role in formulating joint- and technique-specific indications for the management of chondral defects in the hip.

One of the goals of arthroscopically treating chondral defects in the hip is to preserve the hip-joint cartilage and delay or potentially avoid the need for THA procedures. Unfortunately, less than half of the studies in this systematic review reported THA rates after arthroscopic management of chondral defects in the hip.[22,27,28,33] The limited data on the rate of THA after arthroscopic procedures is likely associated with the relatively short follow-up time (11 to 72 months) and the average age of the patient population in these studies (30.1 to 47 years). However, on average, reported THA occurred 8 to 18 months after index arthroscopy and was associated with extensive chondral lesions, joint space narrowing (<2 mm), and older age (mean difference = 18, 95% CI, 8-28, *P* = .001).[27] Although most studies cited advanced osteoarthritis as a contraindication for hip arthroscopy, the reasons for arthroscopic management in these patients were patient-specific (e.g., finish a baseball season) or not discussed. In addition, most studies did not specifically mention which procedure (microfracture *v* ACT *v* debridement) was associated with a higher rate of THA, which precluded any comparison with regard to the delay of THA between surgical techniques. Further studies with strict inclusion and exclusion criteria and long-term follow-up will likely clarify the effectiveness of each arthroscopic technique in the preservation of the hip joint.

Surgical indications for each specific hip chondral preservation or regeneration technique remain unclear, which highlight the importance of attempting to understand patient- and disease-specific management of techniques available for degenerative joint disease.[34] FAI (cam-type) is one of the most common indications for hip arthroscopy, and is frequently associated with concomitant chondral defects, especially in the acetabulum.[24] However, the literature supporting particular modalities by which chondral defects in the hip are addressed varies greatly. Reported indications for microfracture include full-thickness loss of articular cartilage, focal and contained lesions measuring less than 200 to 400 mm^2 in size, Outerbridge grade 3 and 4, lesions in weight-bearing areas or in an area of contact between the femoral head and acetabulum, and unstable lesions with intact subchondral bone.[22,23,25,26,28] However, these indications are not hip-specific and derive from accepted principles for knee microfracture surgery.[8] Indications for ACT were similar including Outerbridge grade 3 and 4 and a lesion diameter of at least 100 mm.[24] However, the decision to treat with ACT instead of microfracture was not discussed and was likely surgeon dependent. Indications for arthroscopic debridement alone were less specific (Outerbridge grade 1 to 4) and only 1 study that met inclusion criteria mentioned lesion size (260 mm^2).[21]

Excluding the studies on elite athletes, whose outcome measures were return to play all, but 3 studies, reported pre- and postoperative NAHS, and/or either a HHS or a mHHS. Overall, patients showed significant improvement in all outcome measures compared with preoperative scores ($P < .05$) (Table 4). However, only the study by Fontana et al.[21] reported a higher HHS 87.4 versus 56.3 ($P < .001$) after ACT compared with debridement alone. Haviv et al.[22] also showed a greater improvement between pre- and postoperative NAHS with microfracture compared with debridement alone (20.2 *v* 13.2), but the improvement based on the surgical technique was not scrutinized with a statistical analysis. The remaining studies did not report any significant difference between groups.

The true prevalence of chondral defects of the hip in the athletic population is unknown; however, a recent study of the prevalence of chondral defects in athletes' knees suggests that cartilage defects are more common among athletes than in the general population.[35] Chondral defects in the hip can occur from FAI, or acute traumatic events such as a subluxation or dislocation.[25] The 3 studies in this review that reported on high-level athletes in sports ranging from Australian rule football, hockey, football, soccer, golf, tennis, and baseball showed encouraging results with arthroscopic treatment of various hip conditions, including chondral defects. Both debridement and microfracture were associated with a high return to play rate (77% to 95.8%). In 1 study, it was noted that 23 of the 24 professional athletes from the Australian Football League returned to play, achieved preinjury level of activity by 3 months, and maintained these results after an average of 22 months.[36] These results suggest that hip arthroscopy is a safe and effective technique to help athletes with various hip conditions return to preinjury levels of sustained ability to play. However, none of these studies were designed to specifically assess outcomes in the arthroscopic management of chondral defects in particular, which limits the ability to control for confounding factors affecting individual results, which include the treatment of concomitant hip pathology arthroscopically.

Limitations

Our study is limited by the level of available evidence of arthroscopic management of chondral defects (Level III and Level IV studies). As such, the results from this analysis should be taken in consideration of the level of evidence available in the published literature. Unfortunately large-scale prospective, controlled trials (Level I) have not been published and are warranted to better characterize the efficacy of specific arthroscopic treatment techniques of hip chondral defects. However, attempts to establish objective criteria for hip arthroscopy as a method of addressing chondral defects have been largely limited by the influence of each individual's expectations and lifestyle.[19] In addition, patient-specific parameters such as duration of symptoms, failed nonoperative treatment, and body mass index, were not consistently reported, which could potentially represent a limiting factor for better outcomes and are important to consider for future studies. Similar to the studies included in this analysis, we excluded cases associated with osteonecrosis. Although osteonecrosis is associated with chondral defects, in these cases the role of arthroscopy is more likely to address coexisting intra-articular pathologies as a staging procedure for patients undergoing revascularization of the femoral head.[2] Given the novelty of these techniques, data are limited to short- and midterm follow-up ranging between 6 and 76 months and only a few studies report on the rate of THA after arthroscopic procedures. Lastly, data analysis was performed by combining surgical indications and outcomes of professional athletes and nonathletes. When data collected from professional athletes were excluded, the differences in lesion size was no longer statistically significant ($P = .148$). However, this was due to a slight increase in the average lesion size for microfracture from 149.5 ± 20.7 to 158.5 ± 6.4 mm^2. Lesion size may still be an important factor to consider in determining the appropriate surgical technique to treat chondral defects about the hip. No other comparisons changed significantly after excluding professional athletes. It is critical for future studies to assess whether various arthroscopic techniques can change the natural history of cartilage degeneration and delay the progression of osteoarthritis in the hip.

Conclusions

This systematic review showed that arthroscopic debridement, microfracture, and ACT are associated with equivalent improvement in clinical outcomes in patients with high-grade chondral defects in the hip in the short- and midterm follow-up. In addition, although there were no differences in patient characteristics and demographics based on the surgical technique, we confirmed the hypothesis that lesion size varied significantly between arthroscopic techniques, and that the decision to use one technique over another may be determined by the size of the defect. Therefore, lesion size is likely to influence the development of hip- and technique-specific indications, and may also represent a useful metric for success of surgical intervention.

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