NON-OPERATIVE MANAGEMENT OF INDIVIDUALS WITH NON-ARTHRITIC HIP PAIN: A LITERATURE REVIEW

Ryan P. McGovern, MS, LAT, ATC^{1,3}

RobRoy L. Martin, PhD, PT, CSCS^{1,2}

Benjamin R. Kivlan, PhD, PT, OCS, SCS¹

John J. Christoforetti, MD^{3,4}

ABSTRACT

Background: Non-arthritic hip pain is defined as being related to pathologies of the intra-articular structures of the hip that can be symptomatic. A trial of non-operative management is commonly recommended before consideration of surgery for individuals with non-arthritic hip conditions. There is a need to describe a non-operative or conservative treatment plan for individuals with non-arthritic hip pain.

Purpose: The purpose of this literature review was to systematically examine the literature in order to identify and provide evidence for non-operative or conservative management of individuals with non-arthritic hip pain. A proposed home exercise program will be provided for individuals with non-arthritic hip pain.

Study Design: Review of the Literature.

Materials/Methods: A literature search of PubMed, Medline, SPORTSDiscus, and CINAHL was conducted. Keywords included: "hip" AND "femoroacetabular impingement" OR "labral tear." Studies were included if they described non-operative management for individuals with non-arthritic hip pain. Studies were excluded if they recommended a trial of conservative treatment without specific management or interventions and/or activity modification without specific details for intervention.

Results: A total of 49 studies met the eligibility criteria and were included in the review. Rehabilitation recommendations were identified from manuscripts including clinical trials, case series, discussion articles, or systematic reviews related to the non-operative or conservative management of non-arthritic hip pain. Rehabilitation interventions focused on patient education, activity modification, limitation of aggravating factors, an individualized physical therapy protocol, and use of a home exercise program.

Conclusions: Rehabilitation should address biomechanical deficiencies with neuromuscular training of the hip and lumbopelvic regions. While the current literature on non-operative management is limited, future randomized control trials will establish the effectiveness of specific physical therapy protocols for individuals with non-arthritic hip pain.

Level of Evidence: 3b

Key Words: FAI, acetabular labral tears, dysplasia, structural instability, movement system

CORRESPONDING AUTHOR

Ryan P. McGovern

106 Rangos Sr School of Health Sciences

Duquesne University

Pittsburgh, PA 15282

Phone: 412-396-1811

Fax: 412-396-5554

E-mail: mcgover1@duq.edu

¹ Rangos School of Health Sciences, Duquesne University, Pittsburgh, PA, USA

² University of Pittsburgh Center for Sports Medicine, Pittsburgh, PA, USA

³ Allegheny Health Network, Pittsburgh, PA, USA

⁴ Drexel University School of Medicine, Pittsburgh, PA, USA

All authors have no conflicts of interest to declare.

INTRODUCTION

Non-arthritic hip pain is described as being related to pathologies of the intra-articular structures of the hip that can cause pain including femoroacetabular impingement (FAI), dysplasia, structural instability, acetabular labral tears, chondral lesions, and ligamentum teres tears.¹⁻³ These conditions primarily occur from microtrauma associated with dynamic movement between the proximal femur and the acetabulum.^{1,4} When left unaddressed, FAI, dysplasia, and structural instability can lead to the progression of acetabular labral tears, chondropathy, and potentially osteoarthritic change.⁵⁻¹¹

Arthroscopic surgical procedures to address structural abnormalities, decrease pain, and improve function have significantly increased over the past decade.¹²⁻¹⁶ However, a recent systematic review found that there is a high prevalence of structural deformities in asymptomatic individuals.¹⁷ Additionally, musculoskeletal impairments such as strength deficits associated with non-arthritic pathology are not necessarily addressed with surgery.¹⁸ Deficiencies in the surrounding hip region musculature may lead to joint instability and excessive motion contributing to structural damage, pain, and decreased function.¹⁸⁻²⁰ It may be possible to decrease intra-articular stresses in the presence of structural abnormalities, through management of muscular deficiencies and avoid the need for surgical correction. An evaluation algorithm and treatment classification has been outlined to identify those with non-arthritic hip conditions that might benefit for a prioritized non-operative treatment program.^{21,22}

A trial of non-operative management is commonly recommended before consideration of surgery, however specific interventions remain a point of controversy. Considering that not all individuals will benefit from surgical intervention and the possibility for management of extra-articular deficiencies to relieve symptoms, a non-operative or conservative treatment plan needs to be described for non-arthritic hip pain. The purpose of this literature review was to systematically examine the literature in order to identify and provide evidence for non-operative or conservative management of individuals with non-arthritic hip pain. A proposed home exercise program will be provided for individuals

with non-arthritic hip pain. The information attained will assist clinicians in making treatment decisions based on the current standard of care for management of non-arthritic hip conditions.

METHODS

A search of the PubMed, Medline, SPORTSDiscus, and CINAHL databases was conducted to include articles from 1997 until July 2017. Manuscripts were identified that presented clinical trials, case series, discussion articles, or systematic reviews for non-operative or conservative management of non-arthritic hip pain. The search excluded single series case reports, abstract-only publications, and editorial commentary. The following key words were used in combination for searching the electronic databases: "hip" AND "femoroacetabular impingement" OR "labral tear."

The literature search included research articles if they met the following criteria: 1) written in English, 2) published in a peer-reviewed journal from 1997 until August 2017, and 3) described non-operative or conservative management for individuals with non-arthritic hip pain. Studies were excluded if they recommended a trial of conservative treatment without specific management or physical therapy interventions and/or activity modification to avoid extreme ranges of motion without specific details for intervention. The primary author reviewed the abstracts of all references retrieved from the search and duplicates were removed. From this search, full length publications were retrieved, and the reference lists of these articles were reviewed for any additional relevant manuscripts.

RESULTS

The initial search identified a total of 2,147 research articles. After applying the inclusion/exclusion criteria and performing an independent search of reference lists, a total of 49 studies met the eligibility criteria. Overall, there were 35 articles addressing FAI, four articles addressing acetabular labral tears, one article addressing dysplasia or structural instability, and nine articles addressing a combination of FAI, acetabular labral tears, dysplasia, structural instability, chondral lesions, and/or ligamentum teres tears as shown in Figure 1.

Figure 1. Search Results of the PubMed, Medline, SPORTS-Discus, and CINAHL databases.

Thirty-two of the articles were review and/or discussion studies, seven were experimental studies, and ten addressed feasibility (pilot) and protocol studies for future randomized controlled trials. These articles were categorized per their level of evidence based on the 2009 guidelines from the Oxford Center of Evidence-Based Medicine.²³ Further evaluation of each article was performed for quality of evidence based on the established Grading of

Recommendations Assessment, Development and Evaluation (GRADE) system with classification of studies as: “high quality”, “moderate quality”, “low quality”, or “very low quality.”²⁴ The discussion and review articles were principally constructed on expert opinion Level 5 evidence, with the systematic reviews utilizing Level 2a and 3a evidence in order to analyze the experimental studies performed on individuals with non-arthritic hip pain.²³ The expert opinions established in these discussion and review articles were classified as “very low quality” due to the uncontrolled nature of clinical observations.²⁴

Of the 32 review and discussion articles: 24 addressed FAI, three addressed acetabular labral tears, one addressed dysplasia or structural instability, and four addressed a combination of FAI, acetabular labral tears, and dysplasia or structural instability. These articles provided comprehensive non-operative management recommendations, a synthesis of which is provided in Table 1. Of the seven experimental studies: three addressed FAI and four addressed a combination of FAI, acetabular labral tears, dysplasia or structural instability, chondral lesions and/or ligamentum teres tears. Of these these four were case series (three prospective and one retrospective), one was a prospective clinical outcomes study, one was a retrospective matched analysis study, and one a descriptive epidemiological study. Detailed descriptions of these studies are found in Table 2. Of the 10 articles addressing future randomized controlled trials: eight were established for patients with symptomatic FAI and two were established for patients with intra-articular hip pain, including FAI, acetabular labral tears, and structural instability/dysplasia. Details pertaining to the specific study design, methodology, and results for the six protocol studies and four feasibility studies are provided in Table 3. No randomized control trials were identified.

Table 1. Recommended Therapeutic Interventions from Review and Discussion Articles.

Therapeutic Interventions	Number of Articles (out of 32)
Hip musculature strengthening	22
Pelvic stability/posture (pelvic inclination)	16
Core muscle strengthening	14
Neuromuscular training	13
Hip muscular stretching/flexibility	12
Manual therapy interventions	12
Dynamic biomechanical control	10
Gait training	4

Table 2. Experimental Studies for Conservative Management of Individuals with Non-Arthritic Hip Pain.

Study	Type of Study (Quality of Study) *	Number of Patients	Age of Patients [Mean $\pm$ SD, (Range)]	Diagnosis	Non-Operative Management	Outcomes
Emara et al. 2011	Prospective case series (Low)	37	33 $\pm$ 5, (23-47)	FAI – cam morphology	4 Stages: 1. Avoidance of excessive physical activity and NSAIDs for 2-4 wk during the acute attack. 2. Physiotherapy for 2-3 weeks. Stretching exercises (20-30 min daily) to improve hip ER and ABD in EXT and FLEX, and to avoid the “W” sitting position. 3. Assessment of the normal range of hip IR and FLEX after acute pain subsided. 4. Modification of activities of daily living predisposing to FAI.	33 patients treated nonoperatively showed improvement: <ul style="list-style-type: none"> Mean HHS improved significantly from 72 before treatment to 91 at the 6-month follow-up and 91 at the 24-month follow-up. The mean non-arthritic hip scores improved from 72 to 90 to 91. Mean VAS for hip pain improved from 6 to 3 to 2. 4 required surgery following nonoperative management.
Feeley et al. 2008	Descriptive epidemiologic study – NFL athletes (Very Low)	678 athletes (738 injuries) 13 FAI and LT (8 treated non-operatively, 5 surgically)	Not defined	FAI and LT	Not defined	8 players returned to playing after physical therapy.
Hunt et al. 2012	Prospective observational clinical outcomes study (Low)	52 (6 lost to follow-up from 58)	35 $\pm$ 11, (18–50)	Pre-arthritic, intra-articular hip disorders (FAI, LT, dysplasia) 32 subjects with only LT, 8 subjects with mild hip dysplasia, and 18 subjects with mild FAI	Goals of therapy: 1. Improve precision of hip motion 2. Prevent hip hyperextension with active or passive motion 3. Prevent rotation of acetabulum on femur under load 4. Prevent dominance of quadriceps and/or hamstrings 5. Improve performance of abdominal muscles and hip flexors, abductors, and short external rotators 6. Muscle retraining during active motions and sustained postures 7. Education on day-to-day activity modification. Perform home exercise program which was not defined.	After 3 months of conservative care, subjects with continued limitations, reduction of symptoms with a diagnostic intra-articular hip injection, and a surgically amenable lesion found on a magnetic resonance arthrogram proceeded to surgery. 23 subjects reported satisfaction with conservative care. 29 subjects chose to have surgery. Both groups demonstrated equally significant improvement in all outcome measures from baseline to 1-year follow-up.
Jager et al. 2004	Prospective case series (Very Low)	17 (9 treated non-operatively, 6 FAI surgery, 2 arthroplasty)	33.6 $\pm$ 14.4 (14-60)	FAI – cam morphology	Not defined	9 non-operative patients complained of pain and hip dysfunction. 8 surgical patients were pain free.
Reynolds et al. 1999	Retrospective case series (Very Low)	22 (11 non-operatively, 11 surgically)	28 $\pm$ 10, (15-50)	FAI – pincer morphology	Not defined	Not defined. Proper diagnosis could allow patients to modify activities and posture to decrease symptoms and possibly alleviate problems related to FAI.
Spencer-Gardner et al. 2017	Retrospective matched paired analysis (Low)	72 (36 waitlisted, non-operative & 36 operative)	Non-operative: 40 (18-58) Operative: 40 (18-58)	Intra-articular pathologies (FAI, LT- cam morphology, chondral lesion, ligamentum teres tear)	All patients in both groups had undertaken at least 3-month’s conservative treatment, including community physiotherapy, before being considered for surgery, and had failed to improve with that treatment. There was no additional management provided to the non-operative group following initial 3-month conservative care.	HA may lead to significant improvements when compared to non-operative management of waitlisted patients with intra-articular pathology of the hip at 18-month follow-up.
Yazbek et al. 2011	Prospective case series (Low)	4	24.8 $\pm$ 1.5 (24 -27)	1 FAI – pincer morphology; 1 LT; 1 LT, chondral lesion; 1 LT, partial ligamentum teres tear	3 phases: 1. Emphasized pain control, education in trunk stabilization, and correction of abnormal joint movement. 2. Focused on muscular strengthening, recovery of normal range of motion (ROM), and initiation of sensory motor training. 3. Emphasized advanced sensory motor training, with sport-specific functional progression.	All patients demonstrated decreased pain, functional improvement, and correction of muscular imbalance. Increased muscle strength for the hip flexors (1%-39%), abductors (18%-56%), and extensors (68%-139%) was shown.
M – male; F – female; FAI – femoroacetabular impingement; ER – external rotation; ABD – abduction; EXT – Extension; FLEX – flexion; IR – internal rotation; HHS – Harris hip score; VAS – visual analog scale; LT – acetabular labral tear; CT – computerized tomography; BMI – body mass index; HA – hip arthroscopy * Quality of evidence based on the GRADE classification system.						

Table 3. Studies Addressing Future Randomized Controlled Trials in Individuals with Non-Arthritic Hip Pain.

Study	Type of Study	Number of Patients (population)	Diagnosis	Proposed, Randomized Group Comparison	Hypothesis/Results	Outcome
Boye et al. 2015	Feasibility (pilot study)	75 (53 and 22 from two separate orthopaedic centers)	FAI	Arthroscopic surgery vs. non-surgical management	28% indicated absolute willingness to participate in the trial. 40% were probably willing or unsure. 32% were not willing. 18.7% had a strong preference for surgery. 2.7% strongly preferred nonsurgical treatment. 78.6% no strong preference for either.	Sufficient patient accrual for a randomized trial of FAI treatment is currently feasible while equipoise still exists among patients and surgeons.
Coppack et al. 2016	Protocol	100 (male military participants)	Intra-articular non-arthritic hip pain	7-day residential (in-patient) intervention vs. 8 PT led, out-patient treatments (over 6 weeks) combined with home exercise program	Hypothesis: A 7-day multidisciplinary residential intervention will result in greater improvement in treatment outcomes compared to individualized outpatient treatment in young adults.	Presents the protocol for a RCT that will compare the effects of a residential intervention with conventional outpatient care on pain and physical function in young patients with non-arthritic hip pain.
Griffin et al. 2016 (1)	Feasibility (pilot study)	42 out of 60 eligible (from 9 hospital centers) Identified 120 surgeons, 1908 patients with FAI treated in 2011-2012 throughout UK NHS	FAI	Arthroscopic surgery vs. conservative care	-84 diagnostic and recruitment consultations in 60 patients were used to develop a model for an optimal recruitment consultation. -The International Hip Outcome Tool (iHOT) at 12 months was identified as an appropriate outcome measure. -Estimated the sample size 344 participants (from 25 centers/18 months).	-It is feasible to obtain ethics approval for this research question and to obtain support from a variety of hospitals. -Clinicians were prepared to take part, with surgeons agreeing to follow a defined operative protocol, and physiotherapists attending a training workshop and agreeing to deliver physical therapy protocol.
Griffin et al. 2016 (2)	Protocol	344 (over a 26-month recruitment period in 24 hospital centers)	FAI	Arthroscopic surgery vs. conservative care (clinical and cost effectiveness)	Hypothesis: Arthroscopic surgery is superior to conservative care at 12 months for self-reported hip pain and function for patients with FAI syndrome.	Primary Outcome: Pain and function assessed by iHOT-33 measured at 1-year. Secondary outcomes: General health (SF-12), quality of life (EQ5D-5L) & pt. satisfaction.
Harris-Hayes et al. 2016	Feasibility (pilot study)	35 (18 treatment, 17 control from Washington University)	Chronic hip joint pain (intra-articular non-arthritic hip pain)	-Movement pattern training (MPT) vs. wait-list control (no treatment) -MPT: Six, 1-hour supervised sessions for task specific training for functional tasks and symptom provoking tasks. Strengthening of hip. Daily home program.	-Retention rates did not significantly differ between MPT (89%) and control groups (94%). -16/18 patients (89%) in the MPT group attended at least 80% of the treatment sessions and reported performing their home program at least once per day.	Primary Outcomes: Retention and adherence rates show that a larger RCT is warranted to assess treatment effects. Secondary Outcomes: PRO's, kinematics, and muscle strength will be utilized in the proposed RCT.
Mansell et al. 2016	Protocol	80 (from Madigan Army Medical Center over 2 years) All 80 surgical candidates who have failed 6 weeks of non-op care.	FAI (with and without acetabular labral tears)	-Arthroscopic surgical decompression vs. non-surgical rehabilitation -Rehabilitation will follow impairment based physical therapy program consisting of 2x per week for 6 weeks.	Primary Purpose: Determine if there is a difference in self-reported functional outcomes between arthroscopic surgery and a supervised physical therapy program 2 years out from intervention. Secondary Purpose: Evaluate the differences in hip-related healthcare utilization and associated costs.	Primary Outcome: HOS. Secondary Outcomes: iHOT-33, GROG, and NPRS. Self-Motivation Inventory and Pain Catastrophizing Scale will be taken at baseline and 24 months. Collect healthcare utilization and associated costs that occurred for the duration of the study, and compare.
Palmer et al. 2014	Protocol	120 (over 24 months from NHS clinics in at least 3 hospitals)	FAI	Surgical management vs. non-surgical management Rehabilitation will follow a goal-based program with up to 8 sessions over 5 months.	Primary Objective: Determine whether arthroscopic surgery or PT and activity modification is more effective in improving symptoms and preventing the development and progression of osteoarthritis in patients with symptomatic FAI. Secondary Objective: Compare cost effectiveness of physiotherapy and activity modification with arthroscopic surgery.	Primary Outcomes: Improvement of symptoms: HOS with ADL and sports subscales. Prevention of osteoarthritis: radiographic with 3-year follow-up. Secondary Outcome: Improvement of symptoms: NAHS, iHOT-33, HAGOS, OHS, and HADS.
Smeatham et al. 2017	Feasibility (pilot study)	23 out of 30 eligible (from a single NHS acute hospital in Devon, England)	FAI	-PT vs. routine care -PT is 3-months of specialist physiotherapist led care. -Routine is analgesia and continuation of self-management advice.	-NAHS for the intervention group was 12.7 and 1.8 in the control group. Median change in LEFS was 11.5 vs. -1.0 in control group. -Improvement in LEFS was beyond minimal clinically important difference in the intervention group. -Pain scores improved in both groups.	Main Outcomes: Conservative treatment can change symptoms of FAI even in the presence of structural abnormalities.
Wall et al. 2016 (3)	Final Protocol (Personalized Hip Therapy [PHT])	13 (from 21 randomized out of 42)	FAI	Protocol for the non-operative group in the UK FASHIoN trial.	Rehabilitation led by physiotherapist: (1) Detailed patient assessment (2) Education and advice (3) Help with pain relief (4) Individualized exercise program. PHT is delivered over 12–26 weeks in 6–10 physiotherapist and patient contacts. Home exercise program.	Main Outcome: PHT provides a structure for the non-operative care of FAI and offers guidance to clinicians and researchers.
Wright et al. 2016	Feasibility (pilot study)	15 out of 18 eligible (from a single surgeon practice from the Department of Orthopaedic Surgery, Wake Forest Baptist Medical Center)	FAI	-Combination manual therapy and supervised exercise (with advice and home exercise) vs. advice and home exercise. -Both groups over a 6-week period.	-No significant between-group differences were observed in pain and function, 1-week after completion of 6-week period. -Both groups showed statistically significant improvements in pain: the manual therapy group improved a mean of 17.6 mm and 18.0 mm for the advice and home group.	Main Outcome: -Evidence that FAI may be amenable to conservative treatment strategies. -Supervised manual therapy and exercise did not result in greater improvement in pain or function compared to advice and home exercise.

FAI – femoroacetabular impingement; UK – United Kingdom; NHS – National Health Service; iHOT – International Hip Outcome Tool; iHOT-33 – International Hip Outcome Tool 33; RCT – randomized control trial; PRO's – patient reported outcomes; LT – acetabular labral tears; HOS – Hip Outcome Score; GROG – Global rating of change ; NPRS – Numeric pain rating scale; ADL – activities of daily living; NAHS – non-arthritic hip score; HAGOS – hip and groin outcome score; OHS – Oxford hip score; HADS – hospital and anxiety depression scale; MRI – magnetic resonance imaging; VAS – visual analog scale; LEFS – lower extremity functional score; PT – physical therapy

(1) Phase 1 of the FASHIoN randomized control trial, (2) Phase 2 of the FASHIoN randomized control trial, (3) Phase 3 of the FASHIoN randomized control trial. UK FASHIoN trial (ISRCTN64081839).

Rehabilitation interventions throughout the identified studies including patient education, activity modification, limitation of aggravating factors, performance of an individualized physical therapy protocol, and performance of a home exercise program, have been shown to decrease pain and improve function in patients with non-arthritic hip pain. Interventions should focus on addressing neuromuscular deficits with rehabilitation of the hip and lumbopelvic regions. Exercise suggestions gleaned from the included studies were used to generate a proposed home exercise program for individuals with non-arthritic hip pain are presented in Appendix A.²⁵

DISCUSSION

This literature review identified studies related to non-operative or conservative care in the treatment of individuals with non-arthritic hip pain. Discussion and/or review articles, experimental studies, and randomized control feasibility and protocol studies addressing management of individuals with FAI, acetabular labral tears, dysplasia, structural instability, chondral damage, and ligamentum teres tears were evaluated. From these studies, several concepts were identified that should be considered when beginning all non-operative management plans including: patient education,²⁶⁻²⁸ symptom control (with the use of non-steroidal anti-inflammatory drugs),²⁹⁻³² identification of aggravating activities,^{31,33} modification of these activities with a focus on limiting extreme ranges of motion,^{29-31,34,35} and initiation of therapeutic interventions within a physical therapy protocol.^{33,36,37} Therapeutic interventions should consist of addressing neuromuscular deficits with training of the hip and lumbopelvic regions.

Physical therapy interventions that were described in the discussion and/or review articles included: hip musculature strengthening (specifically the hip abductors and deep external rotators),^{3,26,29,30,32,34,36,38-52} pelvic positioning and stability related to posture,^{29,30,33,34,36,38,43,44,46-51,53,54} core muscle strengthening,^{29-31,33,34,37,38,40,43,45,46,53,55,56} neuromuscular training focused on hip and lumbopelvic stability,^{3,34,35,37,38,42,45,46,48,50-52,54} stretching and flexibility for the surrounding hip musculature,^{3,30,32,33,36,39,44-46,51,55,57} inclusion of manual therapy interventions focusing on soft-tissue mobilization of surrounding structures

of the hip,^{32,34,41,42,45-47,50,51,54,57,58} dynamic biomechanical control including proprioception, balance, and coordination training,^{3,37,38,41,42,45-48,52} and gait training to address pathological adaptations with use of orthotics if necessary.^{47,48,50,52} It is recommended that all physical therapy interventions should be prescribed and performed on an individualized basis.

The goal of rehabilitation should be to establish dynamic stabilization of the surrounding hip musculature and concurrent core and pelvic control to prevent accessory motion of the hip joint during complex activities.^{34,50} Neuromuscular training of the hip and lumbopelvic regions is important for establishing motor control during sports-related activities.^{50,51} Of note, the discussion and review articles were principally constructed on expert opinion (Level 5 evidence), with the systematic reviews utilizing Level 2a and 3a evidence in order to analyze the experimental studies performed on individuals with non-arthritic hip pain.²³ Recommendations in the current literature review are based on “low” or “very low quality” evidence due to the uncontrolled nature of the clinical observations.²⁴

The experimental studies included in this literature review include Level 4 (case series & descriptive epidemiological study), Level 2b (retrospective matched analysis), and Level 2c (clinical outcomes study) evidence, for the use of non-operative management of individuals with FAI, dysplasia, and structural instability. Three case series (two prospective^{59,60} and one retrospective⁶¹) specifically addressed management of individuals with the diagnosis of FAI. While two of these studies^{60,61} did not specifically define the non-operative management plan that was utilized, Emara et al.⁵⁹ demonstrated a successful plan utilizing four stages of conservative treatment that included: avoidance of physical activity with symptom control during the acute stage, physical therapy with stretching exercises for two to three weeks, assessment of normal hip ROM, and modification/adaptation of ADLs. Prolonged sitting during this time frame was avoided, but if necessary it was recommended that individuals lean backwards periodically to decrease hip flexion and elicitation of impingement causing posture.⁵⁹ Thirty-three of the 37 patients (89%) had positive results from the conservative management plan with both

the mean Harris Hip Score and non-arthritic hip scores improving from 72 to 91 (out of 100) over a 24-month period and visual analog scores for hip pain decreasing from 6 to 2 over the same timeframe.⁵⁹ The results of this case control study suggests that an intervention focused on activity modification and physical therapy can significantly improve hip function and decrease symptoms in individuals with FAI.

Three experimental studies addressed non-operative management of intra-articular disorders including FAI, acetabular labral tears, dysplasia, chondral lesions and ligamentum teres partial tears.^{27,28,62} Two of these studies provided specifics of non-operative management including the case series by Yazbek et al.²⁸ demonstrating a decrease in pain, improvement in functional movement, and increased lower extremity muscular balance in four individuals. This was achieved by correcting abnormal joint movement by emphasizing muscular strengthening and sensory motor training. When the muscle imbalance was corrected, the participants were progressed to a sports-specific functional training regimen and successfully returned to activity over a 12-week period.²⁸ The case series performed by Hunt et al.²⁷ demonstrated a successful management plan in 23 of 52 (44%) individuals with FAI, LT, and dysplasia over a 12-week period. All participants were taken through an individualized physical therapy protocol that emphasized femoral head motion by decreasing the anterior glide within the acetabulum through muscle training and postural positioning of the pelvis.²⁷ This study included a home exercise program but did not comment on the specifics beyond modification and avoidance of everyday aggravating activities. As shown in Table 2, four of the experimental studies were classified as having “low quality” and three as having “very low quality” of evidence.

Level 1 randomized controlled trials (RCT) are the type of study that will establish “high quality” evidence for the cause and effect analysis of non-operative management for individuals with non-arthritic hip pain. While the current literature review did not identify any completed RCT's to date, several feasibility and protocol studies were available in the literature. The five feasibility studies provided in this review demonstrate that a sufficient accumulation

of patients, physical therapists, and surgeons will-ing to participate in future RCTs comparing: surgical vs. non-surgical management of FAI,^{63,64} movement pattern training (MPT) vs. no treatment for intra-articular, non-arthritic hip pain,⁶⁵ physical therapy vs. self-management of FAI,⁶⁶ and a combination of manual therapy, physical therapy, and home exercise vs. advice and home exercise for FAI.⁶⁷ While feasibility studies demonstrate the willingness for participation; protocol studies serve to define the intended treatment and control populations, methodology, and study design. They also establish the intended hypothesis or objectives that the future RCTs would pursue. Four protocol studies were identified in this review, with three describing the comparison of surgical vs. non-surgical management of FAI⁶⁸⁻⁷⁰ and a seven-day in-patient intervention vs. physical therapist led, outpatient intervention with home exercise program, for individuals with intra-articular, non-arthritic hip pain.⁷¹

A study conducted by Wall et al.²⁵ established a suggested rehabilitation protocol based off of a prior feasibility⁶⁴ and a protocol study.⁶⁸ The Personalized Hip Therapy (PHT) protocol provides the specific non-operative management that will be utilized in the FASHIoN RCT.²⁵ The authors identified four rehabilitation components that were to be utilized in their future RCT including: a detailed patient assessment, education and professional advice, symptom control and pain relief, and an individualized exercise-based program.²⁵ Optional, individualized management was also included for treatment of coexisting symptoms, use of orthotics for biomechanical abnormalities, use of corticosteroid injections for patients with severe pain, and manual therapy interventions.²⁵ A home exercise program will be provided for each individual participating in the non-operative group of the RCT.

This literature review has attempted to assimilate the current evidence for use of non-operative or conservative care for individuals with non-arthritic hip pain and suggest an exercise program. The information provided herein may benefit clinicians in making treatment decisions based on the current peer-reviewed literature. The provided home exercise program reflects the author's compilation of exercises utilized within the peer-reviewed literature

and could be performed along with an individualized rehabilitation protocol. There are limitations to this proposed home exercise program that need to be considered when applying the information presented. The proposed rehabilitation interventions and compiled home exercise program are based on the authors interpretation of the current peer-reviewed literature. These recommendations may not be the only viable options for non-operative management of individuals with non-arthritis hip pain. No cause and effect relationships between the proposed exercises and outcomes can be inferred.

CONCLUSIONS

In general, the results of this literature review indicate that rehabilitation intervention focused on patient education, activity modification, limitation of aggravating factors, an individualized physical therapy protocol, and a home exercise program, can decrease pain and improve function in patients with non-arthritis hip pain. Interventions should focus on addressing neuromuscular deficits with training of the hip and lumbopelvic regions. While the current literature on non-operative management is limited, future randomized control trials will establish the effectiveness of specific physical therapy protocols for individuals with non-arthritis hip pain.

REFERENCES

1. Enseki K, Harris-Hayes M, White DM, et al. Nonarthritic hip joint pain. *J Orthop Sports Phys Ther*. 2014;44(6):A1-32.
2. Jorgensen RW, Dippmann C, Dahl L, Sturup J. Treatment Algorithm for Patients with Non-arthritis Hip Pain, Suspect for an Intraarticular Pathology. *The open orthopaedics journal*. 2016;10:404-411.
3. Nicholls RA. Intra-articular disorders of the hip in athletes. *Physical therapy in sport : official journal of the Association of Chartered Physiotherapists in Sports Medicine*. 2004;5:17 - 25.
4. Liem BC, Loveless MS, Apple EL, Krabak BJ. Nonoperative management of acetabular labral tear in a skeletally immature figure skater. *Pm r*. 2014;6(10):951-955.
5. Ganz R, Parvizi J, Beck M, Leunig M, Notzli H, Siebenrock KA. Femoroacetabular impingement: a cause for osteoarthritis of the hip. *Clin Orthop Relat Res*. 2003(417):112-120.
6. Jessel RH, Zurakowski D, Zilkens C, Burstein D, Gray ML, Kim YJ. Radiographic and patient factors associated with pre-radiographic osteoarthritis in hip dysplasia. *The Journal of bone and joint surgery American volume*. 2009;91(5):1120-1129.
7. Giori NJ, Trousdale RT. Acetabular retroversion is associated with osteoarthritis of the hip. *Clin Orthop Relat Res*. 2003(417):263-269.
8. McCarthy JC, Lee JA. Acetabular dysplasia: a paradigm of arthroscopic examination of chondral injuries. *Clin Orthop Relat Res*. 2002(405):122-128.
9. Sierra RJ. The management of acetabular retroversion with reverse periacetabular osteotomy. *Instr Course Lect*. 2013;62:305-313.
10. Harris-Hayes M, Royer NK. Relationship of acetabular dysplasia and femoroacetabular impingement to hip osteoarthritis: a focused review. *Pm r*. 2011;3(11):1055-1067.e1051.
11. Agricola R, Heijboer MP, Bierma-Zeinstra SM, Verhaar JA, Weinans H, Waarsing JH. Cam impingement causes osteoarthritis of the hip: a nationwide prospective cohort study (CHECK). *Ann Rheum Dis*. 2013;72(6):918-923.
12. Colvin AC, Harrast J, Harner C. Trends in hip arthroscopy. *The Journal of bone and joint surgery American volume*. 2012;94(4):e23.
13. Bozic KJ, Chan V, Valone FH, 3rd, Feeley BT, Vail TP. Trends in hip arthroscopy utilization in the United States. *J Arthroplasty*. 2013;28(8 Suppl):140-143.
14. Montgomery SR, Ngo SS, Hobson T, et al. Trends and demographics in hip arthroscopy in the United States. *Arthroscopy*. 2013;29(4):661-665.
15. Griffin DR, Dickenson EJ, O'Donnell J, et al. The Warwick Agreement on femoroacetabular impingement syndrome (FAI syndrome): an international consensus statement. *British journal of sports medicine*. 2016;50(19):1169-1176.
16. Saadat E, Martin SD, Thornhill TS, Brownlee SA, Losina E, Katz JN. Factors Associated With the Failure of Surgical Treatment for Femoroacetabular Impingement: Review of the Literature. *Am J Sports Med*. 2014;42(6):1487-1495.
17. Frank JM, Harris JD, Erickson BJ, et al. Prevalence of Femoroacetabular Impingement Imaging Findings in Asymptomatic Volunteers: A Systematic Review. *Arthroscopy*. 2015;31(6):1199-1204.
18. Casartelli NC, Maffiuletti NA, Bizzini M, Kelly BT, Naal FD, Leunig M. The management of symptomatic femoroacetabular impingement: what is the rationale for non-surgical treatment? *British journal of sports medicine*. 2016;50(9):511-512.
19. Retchford TH, Crossley KM, Grimaldi A, Kemp JL, Cowan SM. Can local muscles augment stability in

- the hip? A narrative literature review. *J Musculoskelet Neuronal Interact*. 2013;13(1):1-12.
20. Lewis CL, Sahrmann SA, Moran DW. Anterior hip joint force increases with hip extension, decreased gluteal force, or decreased iliopsoas force. *J Biomech*. 2007;40(16):3725-3731.
21. Martin HD, Palmer IJ. History and physical examination of the hip: the basics. *Curr Rev Musculoskelet Med*. 2013;6(3):219-225.
22. Frangiamore S, Mannava S, Geeslin AG, Chahla J, Cinque ME, Philippon MJ. Comprehensive Clinical Evaluation of Femoroacetabular Impingement: Part 1, Physical Examination. *Arthrosc Tech*. 2017;6(5):e1993-e2001.
23. Phillips B, Ball C, Sackett D. *Centre for Evidence-Based-Medicine*. Oxford: United Kingdom; 2009.
24. Guyatt GH, Oxman AD, Vist GE, et al. GRADE: an emerging consensus on rating quality of evidence and strength of recommendations. *Bmj*. 2008;336(7650):924-926.
25. Wall PD, Dickenson EJ, Robinson D, et al. Personalised Hip Therapy: development of a non-operative protocol to treat femoroacetabular impingement syndrome in the FASHIoN randomised controlled trial. *British journal of sports medicine*. 2016;50(19):1217-1223.
26. Kaplan KM, Shah MR, Youm T. Femoroacetabular impingement–diagnosis and treatment. *Bull NYU Hosp Jt Dis*. 2010;68(2):70-75.
27. Hunt D, Prather H, Harris Hayes M, Clohisey JC. Clinical outcomes analysis of conservative and surgical treatment of patients with clinical indications of prearthritic, intra-articular hip disorders. *Pm r*. 2012;4(7):479-487.
28. Yazbek PM, Ovanessian V, Martin RL, Fukuda TY. Nonsurgical treatment of acetabular labrum tears: a case series. *J Orthop Sports Phys Ther*. 2011;41(5):346-353.
29. Bathala EA, Bancroft LW, Peterson JJ, Ortiguera CJ. Radiologic case study. Femoroacetabular impingement. *Orthopedics*. 2007;30(12):986, 1061-1064.
30. Pierannunzii L, d'Imporzano M. Treatment of femoroacetabular impingement: a modified resection osteoplasty technique through an anterior approach. *Orthopedics*. 2007;30(2):96-102.
31. Byrd JW. Femoroacetabular impingement in athletes: current concepts. *Am J Sports Med*. 2014;42(3):737-751.
32. Chakraverty J, Snelling N. Anterior hip pain - have you considered femoroacetabular impingement? *International Journal of Osteopathic Medicine*. 2012;15(1):22 - 27.
33. Hart ES, Metkar US, Rebello GN, Grottkau BE. Femoroacetabular impingement in adolescents and young adults. *Orthop Nurs*. 2009;28(3):117-124; quiz 125-116.
34. Bedi A, Kelly BT. Femoroacetabular impingement. *The Journal of bone and joint surgery American volume*. 2013;95(1):82-92.
35. Keogh MJ, Batt ME. A review of femoroacetabular impingement in athletes. *Sports Med*. 2008;38(10):863-878.
36. Kuhlman GS, Domb BG. Hip impingement: identifying and treating a common cause of hip pain. *Am Fam Physician*. 2009;80(12):1429-1434.
37. Samora JB, Ng VY, Ellis TJ. Femoroacetabular impingement: a common cause of hip pain in young adults. *Clin J Sport Med*. 2011;21(1):51-56.
38. Casartelli NC, Maffiuletti NA, Leunig M, Bizzini M. Femoroacetabular impingement in sports medicine: a narrative review. *Schweizerische Zeitschrift für Sportmedizin & Sporttraumatologie*. 2015;63(2):13-17.
39. Jacoby L, Yi-Meng Y, Kocher MS. Hip problems and arthroscopy: adolescent hip as it relates to sports. *Clinics in sports medicine*. 2011;30(2):435-451.
40. Leunig M, Robertson W, Ganz R. Femoroacetabular impingement: Diagnosis and management, including open surgical technique. *Oper Tech Sports Med* 2007;15:178 - 189.
41. Loudon JK, Reiman MP. Conservative management of femoroacetabular impingement (FAI) in the long distance runner. *Physical therapy in sport : official journal of the Association of Chartered Physiotherapists in Sports Medicine*. 2014;15(2):82-90.
42. Nepple JJ, Byrd JW, Siebenrock KA, Prather H, Clohisey JC. Overview of treatment options, clinical results, and controversies in the management of femoroacetabular impingement. *J Am Acad Orthop Surg*. 2013;21 Suppl 1:S53-58.
43. Pierannunzii L. Pelvic posture and kinematics in femoroacetabular impingement: a systematic review. *J Orthop Traumatol*. 2017.
44. Smith DV, Bernhardt DT. Hip injuries in young athletes. *Curr Sports Med Rep*. 2010;9(5):278-283.
45. Tranovich MJ, Salzler MJ, Enseki KR, Wright VJ. A review of femoroacetabular impingement and hip arthroscopy in the athlete. *Phys Sportsmed*. 2014;42(1):75-87.
46. Wall PD, Fernandez M, Griffin DR, Foster NE. Nonoperative treatment for femoroacetabular impingement: a systematic review of the literature. *Pm r*. 2013;5(5):418-426.
47. Groh MM, Herrera J. A comprehensive review of hip labral tears. *Curr Rev Musculoskelet Med*. 2009;2(2):105-117.

48. Lewis CL, Sahrmann SA. Acetabular labral tears. *Physical therapy*. 2006;86(1):110-121.
49. Dangan A, Tardy N, Wettstein M, May O, Bonin N. Microinstability of the hip: A review. *Orthop Traumatol Surg Res*. 2016;102(8s):S301-s309.
50. Gwathmey FW, Jr., Kadrmas WR. Intra-articular hip disorders in the military population: evaluation and management. *Clinics in sports medicine*. 2014;33(4):655-674.
51. Heiderscheit B, McClinton S. Evaluation and Management of Hip and Pelvis Injuries. *Phys Med Rehabil Clin N Am*. 2016;27(1):1-29.
52. Hunt D, Clohisy JC, Prather H. Acetabular Labral Tears of the Hip in Women. *Phys Med Rehabil Clin N Am*. 2007;18:497 - 520.
53. Sink EL, Gralla J, Ryba A, Dayton M. Clinical presentation of femoroacetabular impingement in adolescents. *J Pediatr Orthop*. 2008;28(8):806-811.
54. Zhang C, Li L, Forster BB, et al. Femoroacetabular impingement and osteoarthritis of the hip. *Canadian family physician Medecin de famille canadien*. 2015;61(12):1055-1060.
55. Hackney R. (iv) Groin pain in athletes. *Orthop Trauma*. 2012;26:25 - 32.
56. Pollard TC. A perspective on femoroacetabular impingement. *Skeletal Radiol*. 2011;40(7):815-818.
57. Emary P. Femoroacetabular impingement syndrome: a narrative review for the chiropractor. *The Journal of the Canadian Chiropractic Association*. 2010;54(3):164-176.
58. Schmerl M, Pollard H, Hoskins W. Labral injuries of the hip: a review of diagnosis and management. *Journal of manipulative and physiological therapeutics*. 2005;28(8):632.
59. Emara K, Samir W, Motasem el H, Ghafar KA. Conservative treatment for mild femoroacetabular impingement. *Journal of orthopaedic surgery (Hong Kong)*. 2011;19(1):41-45.
60. Jager M, Wild A, Westhoff B, Krauspe R. Femoroacetabular impingement caused by a femoral osseous head-neck bump deformity: clinical, radiological, and experimental results. *J Orthop Sci*. 2004;9(3):256-263.
61. Reynolds D, Lucas J, Klaue K. Retroversion of the acetabulum. A cause of hip pain. *J Bone Joint Surg Br*. 1999;81(2):281-288.
62. Spencer-Gardner L, Dissanayake R, Kalanie A, Singh P, O'Donnell J. Hip arthroscopy results in improved patient reported outcomes compared to non-operative management of waitlisted patients. *J Hip Preserv Surg*. 2017;4(1):39-44.
63. Boye GN, Murray K, Clohisy JC, Kim YJ. Feasibility of a Randomized Clinical Trial for Treatment of Femoroacetabular Impingement of the Hip. *Orthop J Sports Med*. 2015;3(7):2325967115592844.
64. Griffin D, Wall P, Realpe A, et al. UK FASHIoN: feasibility study of a randomised controlled trial of arthroscopic surgery for hip impingement compared with best conservative care. *Health technology assessment (Winchester, England)*. 2016;20(32):1-172.
65. Harris-Hayes M, Czuppon S, Van Dillen LR, et al. Movement-Pattern Training to Improve Function in People With Chronic Hip Joint Pain: A Feasibility Randomized Clinical Trial. *J Orthop Sports Phys Ther*. 2016;46(6):452-461.
66. Smeatham A, Powell R, Moore S, Chauhan R, Wilson M. Does treatment by a specialist physiotherapist change pain and function in young adults with symptoms from femoroacetabular impingement? A pilot project for a randomised controlled trial. *Physiotherapy*. 2017;103(2):201-207.
67. Wright AA, Hegedus EJ, Taylor JB, Dischiavi SL, Stubbs AJ. Non-operative management of femoroacetabular impingement: A prospective, randomized controlled clinical trial pilot study. *Journal of science and medicine in sport / Sports Medicine Australia*. 2016;19(9):716-721.
68. Griffin DR, Dickenson EJ, Wall PD, et al. Protocol for a multicentre, parallel-arm, 12-month, randomised, controlled trial of arthroscopic surgery versus conservative care for femoroacetabular impingement syndrome (FASHIoN). *BMJ open*. 2016;6(8):e012453.
69. Mansell NS, Rhon DI, Marchant BG, Slevin JM, Meyer JL. Two-year outcomes after arthroscopic surgery compared to physical therapy for femoroacetabular impingement: A protocol for a randomized clinical trial. *BMC Musculoskelet Disord*. 2016;17:60.
70. Palmer AJ, Ayyar-Gupta V, Dutton SJ, et al. Protocol for the Femoroacetabular Impingement Trial (FAIT): a multi-centre randomised controlled trial comparing surgical and non-surgical management of femoroacetabular impingement. *Bone & joint research*. 2014;3(11):321-327.
71. Coppack RJ, Bilzon JL, Wills AK, et al. A comparison of multidisciplinary team residential rehabilitation with conventional outpatient care for the treatment of non-arthritic intra-articular hip pain in UK Military personnel - a protocol for a randomised controlled trial. *BMC Musculoskelet Disord*. 2016;17(1):459.

APPENDIX A: NON-ARTHRITIC HIP PAIN HOME EXERCISE PROGRAM

Exercise 1: Standing Hip Abduction

- Stand with feet together.
- Squeeze both gluteus muscles and lift leg with knee bent at a 45° angle.
- Maintain core, pelvis, and shoulder alignment without allowing any movement of your pelvis.
- Move the lifted leg away from midline, by rotating outward.
- Maintain a contracted gluteus muscle and the standing knee over the second toe.
- Hold for 3 seconds.
- Perform on both sides.

Exercise 2: Mini-Lunge

- Start with a wide stance.
- Lunge forward keeping the lunging knee over the second toe.
- Do not bend the knee past the front of the toes.
- Hold for 5 seconds.
- Perform on both sides.

Exercise 3: Side Lunge

- Start with the feet shoulders width apart.
- Lunge to the side without shifting the hip or trunk, return.
- Maintain an upright core with a straight back position.
- Perform on both sides.

Exercise 4: Wall Slides

- Stand with the back against a wall and feet 18 inches from the wall.
- Slide down so that knees are slightly bent ($\sim 45^\circ$ - 60°).
- Do not go past 90° of knee flexion and keep the knees over the second toes.
- Hold for 15 seconds.

Exercise 5: Single leg balance

- Stand with the non-affected leg towards and touching the wall, with feet shoulders width apart.
- Lean against a wall with the non-affected leg lifted to 90°.
- Isometrically press the non-affected leg against the wall.
- Balance on the affected leg with knee slightly bent and knee over second toe.
- Hold for 5 seconds.

Exercise 6: Eccentric Hamstring Stretch

- Stand on the affected leg with knee slightly bent and arms out to side.
- Maintain a straight back and lean forward
- Extend the hip and knee trying to keep body parallel with the floor.
- Hold for 3 seconds.
- Slowly return to starting position.
- Perform on both sides.

Exercise 7: Side-to-Side Walk

- Perform a side-to-side walk with comfortable stance.
- Step width should maintain a balanced trunk and upper extremities.
- Do not overextend laterally.
- Maintain slightly bent knees ($\sim 45^\circ$ - 60°).
- Perform in both lateral directions for 15 feet.

Exercise 8: Step-Down

- Stand on stool or raised surface.
- Maintain a straight back with unaffected leg off the stool or raised surface.
- Allow unaffected leg to drop until the heel touches the ground by bending the hip and knee, return.
- Keep the knee over the second toe.
- Return to starting position.

Exercise 9: Single Leg Squat

- Stand on the involved leg with back straight and opposite knee bent to 90°.
- Slightly bend the involved knee ($\sim 45^\circ$ - 60°) while keeping the knee over the second toe.
- Return to starting position.

Exercise 10: Hip Flexor Stretch

- Kneel on floor with a straight back.
- Lean forward until a stretch is felt in the front of the back leg/hip.
- Do not let knee go in front of the toes.
- Hold for 5 seconds.
- Perform on both sides.

Exercise 11: Hip Extensions

- Begin on hands and knees.
- Maintain a straight back and contracted core.
- Extend leg while contracting gluteus muscles.
- Do not arch the back or lift the pelvis.
- Hold for 5 seconds.
- Perform on both sides.

Exercise 12: Bridge

- Lay on the ground with knees flexed.
- Lift hips as high as possible while maintaining a contracted core and gluteus muscles.
- Hold for 5 seconds.
- Lower to starting position.