An Updated Hip Arthroscopy Protocol

Nevada Physical Therapy

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Hip Flow Master

Nevada Physical Therapy Hip Arthroscopy Protocol

Wk 0-2		Wk 5-6		Wk 9-12		HEP Wk 11-16	
Stationary Bike	☑	Sidelying Hip ER (Deep Rotators)	☑	Rev. Sled Drags	☑	FABER Slides	☑
Heel Slides to 90 deg Hip flexion	☑	Sidelying Clam Shells	☑	Resisted Stool Rotations	☑	Walking Knee to Opp. Shoulder	☑
Banded Ankle Isotonics	☑	Bridge Variations	☑	KB RDLs	☑	Walking Knee to Chest	☑
Reverse Butterfly	☑	Quadruped Fire Hydrant	☑	1L RDL	☑	Hip Flexor, Hamstring, Quad, Pirifromis Stretches	☑
Hip ABD with IR inStanding	☑	Stool Rotations	☑	Hamstring Curls	☑	Front/Side Planks	☑
OH Abs/Pullovers	☑	Knee Extensions	☑	1L Bridge -> Hip Thruster	☑	Hip Series	☑
Quad/Glute Isometric Sets	☑	Reverse Lunge	☑	KB Squat to above 90 deg	☑	**Return to Sport:**	**Wk 16+**
Cat/Cow	☑	2-Way Glider/Steps	☑	Step Ups	☑	Banded Box March	☑
Hip Extension Ball Roll-outs (wk 2)	☑	Squats/Hip Hinge (bodyweight)	☑	Knee Extensions	☑	KB Triple Flexion	☑
Wk 3-4 (with above)		Hip Hikers	☑	Copenhagen Isometrics	☑	KB Hip Flexion (Thomas)	☑
2L Bridges	☑	**Wk 7-8**		Lateral Lunge	☑	Copenhagen Planks (Reps)	☑
Glute Max Holds in Sidelying	☑	Leg Press <90 deg Hip Flexion	☑	Side Plank Progressions	☑	Sport Specific Skill Progressions	☑
Prone Hip Extensions	☑	1L leg Press <90 deg Hip Flexion	☑	**Wk 13-16**		RTS Deficit Programing	☑
Banded TKE within WB precautions	☑	2L Balance-> 1L Balance	☑	Resisted Lateral Agility	☑	**Return To Sport Testing**	
Prone Hamstring Curls	☑	Decline Slant Board Squats <90 deg Hip Flexion	☑	BB Back Squat	☑	HOS ADL >96% and HOS Sport >78%	
Reverse Clams (IR)	☑	1L Balance -> 1L RDL	☑	BB Deadlift	☑	HIP-RSI >80%	
Weight Shifts/Tall Kneeling	☑	1/2 Kneel Chops/Lifts	☑	Tri-Planar Lunge or Y-balance Drills	☑	Symmetrical Painfree PROM to UNINV Hip	
HEP WK 1-4		Step-Ups, BW <12"	☑	Nordics/Rev Nordics	☑	>90% LSI Copenhagen Plank Testing @ 18" box	
Circumduction (CW/CCW)	☑	Short Lever Side Planks	☑	Glute Medius Side Plank	☑	>90% LSI Side Plank with Hip ABD Testing	
IR Long Axis Log Rolls	☑	Pallof Press	☑	Jump Block 1 (Decel emphasis)	☑	>90% LSI Hip Strength all planes	
Thomas Stretch (modified), Cat/Cow	☑	Reverse Sled Drags	☑	Agility Skills	☑	>90% Single Hop Testing	
Hip ABD with IR	☑	**HEP WK 5-10**				Vail Lateral Agility Test =/>14 pts	
Reverse Butterfly	☑	Butterfly/Rev. Butterfly Stretch	☑	Front/Side Planks		Anterior Y-balance <4cm deficit compared to UNINV	
Quad/Glute Sets/TKEs/Ankle isotonics	☑	Thomas Stretch, V-Stretch, Long Sit Hamstring Stretch	☑	Standing Hip ABD with IR		Established 70% 4 week *average* workload of normal 7 day in-season demands	
Stationary Bike	☑	Seated FABER Slides	☑	Hip Series		**Hip Series:** Quadruped Diagonals x 20, 2L Bridge x 20, 1L Bridge x 20, Prone Hip Extensions x 20	

Introduction

Hip arthroscopy utilization to treat femoroacetabular impingement, labral tears, and other intra-articular hip pathologies has increased exponentially over the last two decades (1,2), however there appears to be a dearth of quality research to support rehabilitation guidelines and clinical decision making. Heerey et al. state regarding post-operative management that "exercise selection has often been based on theoretical constructs that have no underpinning of clinical evidence" (3). A recent review published in 2020 (4) investigated structured physical therapy for hip arthroscopy as it related to patient-reported outcome measures and was able to include only six articles; the most recent being published in 2018 (3). Much of the research published is either anecdotal or built off out-dated and/or inaccurate research. For example, one of the most heavily cited authors in this area (5), in their 2016 publication, suggest hip adduction and internal rotation due to glute medius weakness causes increased strain on the repaired labrum although no citation for this statement is provided (6). Strain studies performed by Safran et al. (7) show no significant increase in strain on either the anterior or superior labrum in this position although it should be noted this was a cadaver study and compression forces were not applied. Similarly, minimal strain on the labrum was noted in closed chain tasks such as standing, ascending or descending stairs (8). Both papers suggest that in an anatomically normal hip, the labrum is not significantly involved in load distribution with daily activities.

Domb et al. was published in 2016 with a total of 18 citations with only four of those references being published in the last 10 years (6). Pubmed searches for "hip arthroscopy protocol", "labral repair protocol", "hip arthroscopy rehabilitation" and similar yield few relevant results with the most recent protocol published in 2018 (3,9) suggesting a need for an updated approach. Several systematic reviews and meta-analyses have been conducted on the current state of rehabilitation after hip arthroscopy and demonstrate a continued need to improve our scientific foundation for clinical management (10,11). This protocol was written to update clinicians on the current state of the research and guide clinical decision making although it remains to be validated.

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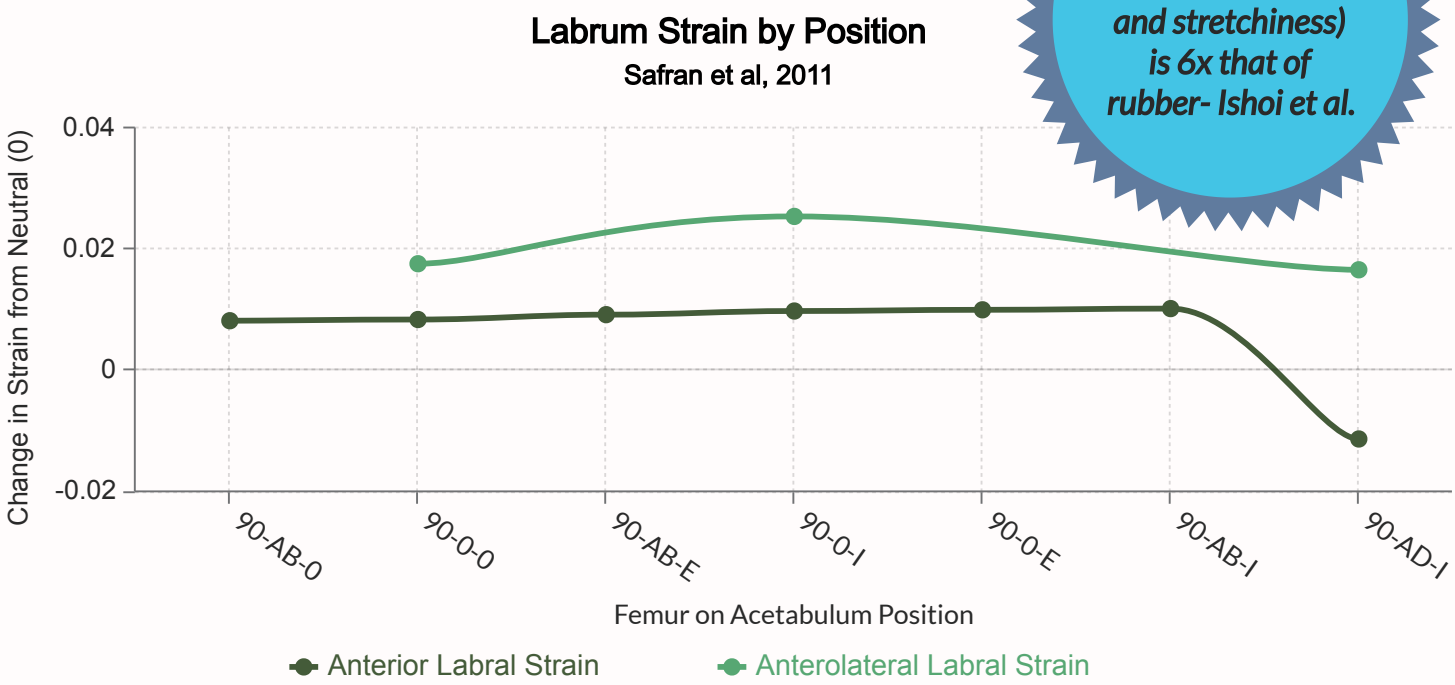
Introduction (cont'd)

Biomechanically, the labrum increases the articular surface of the hip by approximately 22% (12) and acts as a fluid seal creating a “suction effect” to reduce hip joint distraction (7). Crawford et al. showed a 43-60% reduction in force required to distract the hip 3mm when the labrum was ventilated or when an artificial 15mm tear was created (13). This fluid seal is thought to support hydration of the articular cartilage and decrease articular cartilage stress in the fluid phase (14) although this hydrostatic pressure system and its relationship to articular cartilage health continues to be investigated. A recent publication has shown removal of the labrum did not seem to significantly increase cartilage contact stress despite increased force applied to the cartilage in the solid phase (8). Increased displacement at the cartilage edge on the articular surface, a proposed mechanism for osteoarthritis, was identified with labral resection, however (15). More research is needed to draw long term conclusions on labral insufficiency as it relates to joint health, function, and quality of life in later years.

As previously mentioned, the labrum itself has a small load-bearing component in anatomically normal hips; bearing approximately 1-2% of the load with activities like walking and ascending or descending stairs (8) and 0-4% with squatting (15). This percentage increased to 4-11% with gait and stair navigation tasks when dysplasia was present (8). Safran et al. (7) studied strain forces in the labrum with different loading positions with the strain values that reached statistical significance illustrated on the following page.

Introduction (cont'd)

Labrum tensile modulus (stiffness and stretchiness) is 6x that of rubber- Ishoi et al.



(Horizontal axis: X-Y-Z (X=Flexion, Y=ABD, Neutral or ADD, Z= IR, Neutral or ER); FADIR position (90-AD-I) included for demonstrative purposes although was not statistically significant from neutral

While load forces change based on hip positioning, the failure rate appears to be well above these peak strain thresholds, 10.4%(16) and 8% (17) respectively. It should be noted, that while failure rates were established in surgically excised samples in vivo, the average age of the participants was 60 years old (age range 35 to 78 years old) and human tissue free of pathology has not been investigated to this author's knowledge.

Risk factors for Groin Strains and Labral Tears

Femoroacetabular impingement, trauma, capsular laxity, hypermobility and dysplasia have been identified as risk factors for labral injury (7). None of the risk factors listed are considered modifiable; this protocol includes risk factors for hip and groin injury (i.e. adductor/psoas strain) to help guide Return to Sport testing. While we recognize the logical leap, this protocol relies on the current evidence of post-operative predictors for hip arthroscopy outcomes AND an emphasis on decreasing modifiable risk factors for hip and groin injury. TL;DR- Research regarding risk factors for labral tear and/or groin injury are conflicting and warrant continued research.

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Risk Factors for Hip And Groin Injuries

Niemuth et al. (18) found decreased hip abduction and hip flexion strength and increased adductor strength as significant risk factors for injury in runners compared to uninjured controls although Markovic et al. found adductor weakness and side to side asymmetry to be significant risk factors (19). Adduction strength of less than 80% of abduction strength in hockey players demonstrated a 17:1 increased relative risk of sustaining a groin injury (19). Langhout et al. report previous injury as the primary risk factor for future injury (20) although Markovic et al. did not (19); however this is noted by Markovic et al. to be potentially related to the small sample size of their study. While total hip rotation of less than 85 degrees has been identified as a risk factor (21), Short et al. (22) note that using this metric would effectively include the majority of all athletes in specific sport populations thus potentially limiting its value.

Trends in research seem to suggest decreased absolute and relative adduction strength, adduction:abduction strength of less than .8, level of sport participation, and lower level of sport-specific training as risk factors for groin injury (23) although care should be exercised with over-extrapolating this date to the general patient population.

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Preoperative Considerations

While the biopsychosocial (BPS) model is not new, it has seen a significant increase in popularity over the last several years. Although it is not the intent of this protocol to discuss the BPS model in depth, the psychological research around hip arthroscopies warrants specific attention. Stone et al., whose group has several publications in this area, investigated risk factors for those experiencing persistent post-surgical pain after hip arthroscopy (24). They found two primary risk factors for persistent post-surgical pain: surgical revision and positive history of anxiety or depression diagnoses. They defined persistent pain as a VAS >30 at 2 years follow up which was the arbitrary cutoff of the top 25% score for participants. Summary: 174 of the 688 patients fell into the persistent pain inclusion criteria with a 1.88 odds ratio, 95% CI 1.02-3.32 p value .042 = 84% more likely to have persistent pain.

In 2018, an investigation by Rosenblum et al. (25) had a smaller participant pool (as did the majority of the studies investigating this topic) with 51 patients participating and reported 45.1% of participants as having a positive medical history of psychiatric diagnosis of mental illness (compared to 23% in the control group consisting of similarly matched patients undergoing knee arthroscopy) with an odds ratio of 3.4. For those interested more in this topic, this paper does an excellent job of summarizing other studies in this area and further reading is recommended. *However*, there is research showing 42% of patients undergoing ACLR were classified as having mild to moderate depression based on the Quick Inventory of Depressive Symptomatology (QIDS) scale published in 2016 (26).

> *When in doubt, refer out. QIDS score of 11-15= moderate depression, 16-20 = severe depression.* -Yeung et al. 2012

Baron et al. investigated failure rates (failure being defined as revision hip arthroscopy or conversion to a total hip arthroplasty) in individuals undergoing primary hip arthroscopy and reported the presence of psychiatric comorbidities as an independent risk factor for revision of primary hip arthroscopy. Additionally, they reported 18% of those undergoing hip arthroscopy required additional surgery. (27)

Table 2.

Image source: Baron et al., 2020

Risk Factors for HA Failure

Variable	Odds Ratio (OR), (95% Confidence Interval, p-value)		
	Revision HA	THA	HA Failure
Preoperative Narcotic Use	0.89 (0.49-1.57,0.69)	1.54, (0.95-2.48,0.07)	1.27 (0.86-1.87,0.22)
Smoking	1.2 (0.51-2.5,0.65)	2.61, (1.46-4.52,<0.01)	1.94 (1.16-3.16,<0.01)
Diabetes	0.74 (0.25-1.74,0.53)	2.04, (1.09-3.65,0.02)	1.43 (0.82-2.41,0.19)
Obesity	1.43 (0.61-3.0,0.37)	1.32, (0.63-2.52,0.43)	1.35 (0.75-2.32,0.29)
Osteoarthritis	0.59 (0.313-1.07, 0.09)	3.24, (1.98-5.43,<0.01)	1.59 (1.08-2.34,0.02)
Psychiatric Comorbidities	2.61(1.14-5.46,<0.01)	2.09, (0.98-4.09,0.04)	2.72 (1.50-4.79,<0.01)
Age < 40	2.58 (1.46-4.59,<0.01)	4.74, (2.4-11.1,<0.01)	1.33 (0.87-2.04,0.19)
Male Sex	0.82, (0.44-1.47,0.52)	0.75, (0.45-1.24,0.28)	0.79 (0.50-1.14,0.19)

18% of those undergoing primary hip arthroscopy required additional surgery- Baron et al., 2020

Preoperative Considerations (cont'd)

After surgical intervention, patients with mild depression symptoms responded better to surgery than those with moderate to severe depression symptoms although improvement was seen in both groups (28). It is important to note that patients experiencing moderate to severe depression did still report improvement in quality of life and function, just less so compared to individuals with no or mild mental health symptoms (29). Post-operative outcomes are explored in more detail in the Return to Play section of this protocol.

Pre-operatively, hip extension weakness has been identified as an independent predictor for less favorable postoperative outcomes (29). Hip flexion weakness at 16 weeks and even 8 months post-op (31-32), persistent decrease in dynamic hip external rotation (noted with athletes even at time of return to sport (33)) and altered single leg squat performance 1 to 2 years post-hip arthroscopy (34) have all been documented in the research. Other risk factors may include presence of osteoarthritis, length of symptoms >2 years, obesity, being female, and many other others although continued research is needed in this area. (35). Improving our ability to identify risk factors pre-operatively may improve our ability to establish accurate expectations for our patients undergoing hip arthroscopy as well as inform the clinician's program design and development.

Post-Operative Considerations

One of the most common questions a patient will ask when seeking care for an injury, especially post-surgical intervention, is "when can I get back to doing the things I love?" In regard to hip arthroscopy, this is an area where there are very few resources available for both clinicians and patients on what to expect after surgery. With the 18x increase in procedures performed between 1999 and 2009 (24) and the 250% increase in hip arthroscopy procedures performed between 2007 and 2011 (36) , it should follow that clinicians are able to accurately set expectations for patients for the next several months of rehabilitation. As described below, this does not match reality.

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Post-operative Considerations (cont'd)

A recent study by Jones et al. investigated the mismatch between patient expectations and reality after hip arthroscopy. While the sample size was relatively small, the findings appear to support clinical presentations; specifically that every patient in this group demonstrated a mismatch in expectations and return to activity at six months post-op (37). They routinely reported having an anticipated timeline of approximately 3-4 months to be back to prior level of function. One interviewee is quoted "*I feel like it's much slower than I thought -I really had projected about 3, 4 months then really believed that I would probably be back to normal by then -I don't know why I thought that.*" Many of these beliefs came from healthcare providers, which may also suggest that it is not only patients who do not have an accurate grasp on what to expect but also the medical personnel involved in this process. Setting expectations for the road ahead is, in our opinion, one of the most essential services we provide for patients; if you know what is coming then you are likely able to minimize the psychological effects (anxiety, frustration, depression, etc.) often seen when expectations do not match reality. Many patients in this study reported experiencing these emotions as they went through the rehab process, commonly referencing things like "*(it's) this last 3 months that my frustration has grown more, because it hasn't progressed for me in the way that I would have thought. That's been really hard.*" As previously described regarding psychological considerations for patients, it should come as no surprise that when an individual realizes unmet expectations, negative emotional experiences often follow. Curiosity of the origin of these expectations was the purpose of this investigation and subsequently, creating a resource for patients that have recently undergone or are considering hip arthroscopy to help calibrate expectations.

"It is likely that some misconceptions and conflicting information from health professionals reflect the lack of clarity in rehabilitation protocols"
- Jones et al., 2020

"...return to sport alone is a poor indicator of treatment success...return to sport may reflect the desire or need for these athletes to return to their profession as fast as possible."
-Thorborg et al., 2018

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Phase 1 (Day 1-28 post-op)

Patients are strongly encouraged to be seen within 72 hours of surgery to establish rehabilitation expectations and decrease the potential of inadvertently developing movement habits that may complicate rehabilitation or place excessive strain on the repair. If possible, a visit prior to surgery can help set the stage for a smooth transition from surgery to rehabilitation.

Phase 1 of this protocol should last between 1-6 weeks depending on criteria-based progress. There are several goals in this phase beginning with protecting the tissue and allowing healing to occur. Weight bearing precautions vary between non-weight bearing and weight bearing as tolerated (9-10,43) and most protocols progress to weight bearing as tolerated over the first 3-4 weeks (44-47,9). Guidelines may vary based on whether a labral repair or debridement was performed and the extent of bone resection needed to restore hip function, microfracture, hip dysplasia, etc. can all affect weight bearing progressions and consultation with the surgeon is recommended.

Weight bearing Considerations: Protocols for hip arthroscopy rehabilitation nearly unanimously report partial weight bearing for the first several weeks following surgery (11); this protocol recommends weight bearing as tolerated in the absence of additional concomitant injury, e.g. microfracture, osteopenia, dysplasia or extensive femoral neck resection. In a recent study completed by Avnieli et al., no differences were found between individuals that could progress weight-bearing as tolerated compared to those who were delayed. Additionally, they report that labral repair failure was associated with persistent bony impingement rather than weight bearing status (43). Femoral neck fracture was associated with greater than 30% of the femoral neck being resected although the overall risk of femoral neck fracture was 0.1% (48). Allowing weight bearing to be progressed based on the individual's tolerances, history and surgeon guidelines may minimize secondary symptom development such as hip flexor tendinopathy or Achilles contracture (46, 49) and facilitate phase progression based on impairment rather than timeline alone (3).

Precautions:

- **Avoid straight leg raises (Spencer-Gardner et al. 2014)**
- **Avoid sitting longer than 30 mins at a time (Kuhns et al.)**
- **Avoid pivoting on involved Limb (Spencer-Garner et al. 2014)**
- **Utilize ice and anti-inflammatory medications as prescribed/needed**
- **No active hip flexion >4+ weeks (Adib et al. 2018)**

Common Pitfalls:

- **Excessive Weight Bearing**
- **Pushing through pain during mobility and stability progressions**
- **Rapid progression of exercise volume and intensity**
- **Under-utilization of ice and anti-inflammatories**

Progression Criteria:

- **Normalize PROM within precautions**
- **Normalize gait with appropriate aide**
- **<3/10 verbal pain scale**

THE PROTOCOL

In addition, there are usually movement precautions such as avoiding excessive hip extension, external rotation, and actively raising the surgical leg (45, 46) to minimize stress to the repaired tissue or hip aggravation. Other goals of phase 1 include appropriately managing pain (9,45,51,52), restoring hip mobility between 75-90% of the uninvolved hip or within PROM precautions (9, 47, 50), normalizing gait with gait aids such as crutches (45,50,52), and beginning strengthening exercises (9,44-47, 50-54).

Phase 1 (cont'd)

Week 0-2

- **Heel Slides to 90 deg Hip flexion**
- **Banded Ankle Isotonics**
- **Quadruped Rockbacks**
- **Cat-Camel**
- **OH Abs/Pullovers**
- **Quad/Ham/Glute Isometric Sets**
- **TKEs**
- **Standing Hip ABD w/ IR**
- **Stationary Bicycle, no resistance, <90 deg hip flexion**
- **Weight shift to tolerance, WBAT progressions***

Week 3-4

- **Prone Hip Extension Ball Rollouts**
- **Standing Hamstring Curls**
- **Glute Max Sidelying Holds**
- **Reverse Clams/ER Clams**
- **Tall Kneeling**
- **Calf Raises**

By the end of phase 1, an individual should be able to move around their home independently, perform most of their normal daily activities such as clothing and self-hygiene, and tolerate lower level exercises as delineated in table 1. One common pitfall of particular interest is the tendency of developing hip flexor tendinopathy (9-10, 44-47). Adib et al. reported approximately 24% of subjects developed hip flexor tendinopathy after hip arthroscopy in their 2018 investigation (49). For this reason, straight leg raises, holding the foot off the floor in front of the body while using crutches, and getting in and out of bed without assistance of your uninvolved leg may become problematic early in the rehabilitation process.

THE PROTOCOL

Phase 2 (5-12 weeks)

During this phase, the first priority is to regain mobility in the involved hip closely followed by developing work capacity and strength required to begin participating in low levels of sport or activity specific movement. Normalizing end range passive mobility is emphasized as precautions are lifted. Persistent hip flexion PROM deficit was noted by Worner et al. at 8 months (+/- 2.6 months) despite this often being when most athletes are cleared to return to sport (32) and subsequently, PROM greater than 90% of the uninvolved side in all planes is emphasized for progression to phase 3. Building these physical characteristics (mobility, capacity, and strength) takes time and rushing through this phase may increase the risk of regression and poorer outcomes when it comes to returning to sport (46) and patience with the process is encouraged. To help illustrate this point, studies from one group exclusively treating elite professional athletes demonstrated that the mean time to return to sport activities was on average 3.4 months (56, 57) and full return to sport was 5.7-9.2 months for professional soccer players (58). In addition, it is commonly reported that most individuals have capacity deficits prior to having surgery; *capacity* being defined as mobility, strength, stamina, etc. and subsequently, developing these physical characteristics after surgery is strongly encouraged (55,59). These themes are emphasized in this phase but continue throughout the rehabilitation process.

Precautions:

- **No sidelying hip abduction > 6wks**
- **No elliptical or stairmaster >12 wks**
- **Avoid rotation in CKC under load >10+wks**

Progression Criteria:

- **ROM symmetry (except flexion/ER)**
- **Normalize gait**
- **Negative Trendelenburg**
- **Hip ABD 4/5 or 30 sec Side Plank**
- **FABER 50% of UNINV**
- **Y-Balance <8cm deficit all planes**
- **HOS ADL of at least 89%**

Author's Note: Secondary training of the uninvolved side, core, modified cardio etc. should be established by this time!

Mobility/Flexibility

- **Thomas Stretch as tol.**
- **Butterfly Stretch**
- **Long Sit Hamstring Stretch**
- **V-stretch**

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Week 4-8 (Phase 2A)

- **Sidelying Clam Shells**
- **Bridge Variations**
- **Quadruped Fire Hydrant**
- **2 Way Glider Drill**
- **TRX Squats**
- **Reverse Lunge**
- Reverse Sled (light)
- Bodyweight Hip Hinge/Squats

Week 8-12 (Phase 2B)

- **Leg Press <90 deg Hip Flexion**
- **1L leg Press <90 deg Hip Flexion**
- **2L Balance-> 1L Balance**
- **Decline Slant Board Squats <90 deg Hip Flexion**
- 1L RDL
- **Resisted Stool Rotations**
- **KB RDLs**
- **Short Lever Side/Front Planks**

THE PROTOCOL

Phase 3 (12-16 weeks)

As previously mentioned, strength deficits are likely to have existed prior to surgery and often persist long after formal rehabilitation is completed (29-33) and for this reason, progressive strength training is emphasized during this phase in anticipation for reintegration into sport or recreational activities. Meeting phase 3 progression criteria should also include the implementation of a strengthening program that has been demonstrated to be reproducible and implemented independently by the patient. Patients are seen 1-2x per month during this phase and a strength program able to be completed outside of clinic visits should be prioritized. Once mobility progression criteria have been met (95% or greater of the uninvolved side) and limb symmetry deficits have reached a minimum threshold (90% of uninvolved side), rate of force development begins to be progressively emphasized over the course of this phase. This may include force absorption, eccentric control, acceleration, deceleration and change of direction proficiency.

Week 12-16

- **Banded Side-Steps**
- **Copenhagen Isometrics**
- **Barbell RDLs/Deadlifts**
- **Barbell Back Squat**
- **Knee Extensions**
- **Hamstring Curls**
- **Side Plank Progressions**
- **Step Ups**
- **Lateral Step Downs**
- **Pallof Press**
- **Resisted Hip Flexion KB Triple Flex. (wk 14+)**
- **Resisted Hip Flexion Banded (wk 14+)**

Progression Criteria

- **>90% LSI on all HHD testing (except hip flexion)**
- **>94% on all Y-balance testing**
- **>80% LSI Hip Flexor Strength**
- **Tolerate Phase 1 skill and plyo work with good tolerance (<2/10 pt VAS increase)**
- **10x Single Leg Squats**

Establish an independent program completed outside of the clinic!

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THE PROTOCOL

Phase 4 (16+ weeks)

This is potentially the longest phase in rehabilitation and time to return to play will vary based on the surgical procedure, progress with rehabilitation, and level of play being returned to, among a host of other contextual factors. Goals of this phase are to maintain a regular strength-based program and begin incorporating power, speed, and reintegration into sport with good tolerance. During this phase, sport-specific activities will be incorporated and once tolerance to mobility, strength, and work capacity development have been established, light practice may begin while maintaining a regular training program. Strength, power, and speed training will increase in the program to meet the demands of sport depending on the sport, position, time in season, and individual athlete traits. There is likely a strong desire to return to sport and activity and patients often have an expectation of returning to sport at 4 months although, as discussed above, this does not often match reality (60,40). Not only is average return to play around 7 months on average after hip arthroscopy but recent research also suggests only 57-74% return to their prior level (39-40). Physical therapy following hip arthroscopy is typically under dosed over the course of 24 weeks (61-62) *and* underloaded (55) due to most rehabilitation studies reporting rehabilitation protocols that follow mostly table-based, low-load, non-functional exercises for the majority of the program (54). For this reason, Phase 4 of this protocol incorporates high-load, functionally-based exercises to promote adequate preparation in the individual's return to sport rehabilitation. Phase 4 is completed with successful completion of the RTP battery as described below.

Hip arthroscopy, at first glance, has a very high success rate with return to sport often reported to be anywhere from 85-95% depending on the author (39, 41) however these rates may be overly optimistic. The infographic below shows commonly reported rates of improvement in function, return to sport, etc. from various publications but what may matter more is how we are *defining* Return to Play or Return to Sport. O'connor et al. completed a meta-analysis on the topic and found an average RTP of 7.4 months with 84% of the 1296 participants returning to play. However, a significant difference was noted between levels of competitiveness and rate of RTP: recreational athletes RTP was 66.7-84% with professionals being in the 82-93% range although subjective reporting of *quality* of play was not reported (38). With some authors reporting anywhere from 17%-74% of athletes making it back to the equivalent or better level of play (39-40) and other authors reporting 92% (41), it becomes clear that more research is needed.

Return to Sport Expectations following Hip Arthroscopy

Patient Expectations

Patients often believe 3-4 months until they can return to PLOF (Jones et al. 2020)

Patient Reality

Majority of improvement comes in the first 3 months although continued improvement is seen for up to 2 years especially in RTS (Flores et al. 2018)

87-93% RTS but only 55-83% to Prior Level of Competition (Parvaresh et al. 2020)

NCAA

Majority of improvement is seen in the first 3 months in ADLs, Pain, QoL, however only 62% reached acceptable Sport and Recreation Participation by 6 months. (Thorborg et al. 2018)

89.7% RTS however endurance athletes were at 66% RTS at 2 year follow up. (Weber et al. 2020)

NBA

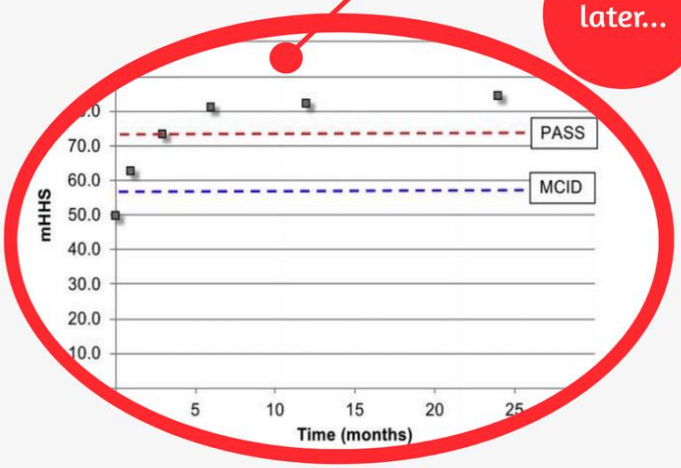
87.5% returned to play at 5.7 +/- 2.6 months; 1 year survivorship in the league: 79% (Jack et al. 2020)

Professional Soccer

At 2 years post-op, 93% passed MCID and (Wolfson et al. 2019)

RTS average for pro-soccer was 9.2 months with National Team players ~5.7mo. (Locks et al. 2019)

2 years later...



Return to Play

These wide variations in RTP rates may be due to, in part, that most of the studies were completed in populations where many of the surgeries were done by one surgeon in a high-volume setting which may bias the findings previously reported (41). Defining terms seems to be key in creating an accurate expectation on RTP after hip arthroscopy, specifically Return to Play vs Return to Participation vs Return to Play at Pre-injury level, etc. There is clearly a need for additional research on rehabilitation protocol efficacy, objective RTS criteria, and a more comprehensive assessment of the multifactorial aspects of an athlete's readiness to return to the field. Specifically things like external motivation to play (38), psychological readiness (63), etc. all may contribute to a successful RTP for a post-surgical athlete.

Return To Play Testing Battery

- **HOS ADL >96% and HOS SPORT >78% (9, 71, 73)**
- **>90% LSI with Single Hop Testing (45)**
- **>90% LSI Copenhagen Plank/Side Plank with Hip ABD Testing**
- **>94% LSI Y-Balance (75-76)**
- **HHD LSI >90% (flexion, extension, abduction, adduction, internal and external rotation) (9)**
- **Hip ADD:ADD greater than .8 (19)**
- **Vail Lateral Agility Sport Test Score 14/15 (9)**
- **HIP-RSI >80% (63)**

Return to Play (RTP) Criteria

While there are many similarities between rehabilitation of the post-surgical ACLr patient and post-op hip arthroscopy patient, one of the primary differences is a lack of RTP objective criteria for those who have undergone hip arthroscopy. While ACLr research has a wealth of RTP studies (yet very little agreement), there are far fewer hip arthroscopy publications. Recent systematic reviews investigating post-operative rehabilitation for hip arthroscopy often yielded less than 40 articles from which the reviews could be performed (39, 64-65) and of those protocols, high variability is noted between them (11).

With regard to RTP criteria, there is even less data to guide clinical decision making as demonstrated in a review completed in 2019 which reported 64% of the included studies used *"completed rehabilitation program"* as their RTP criteria (65). O'connor et al. used a four-point scoring on RTP protocols (timeline, conditional criteria, specific measurements for conditional criteria, and rehab protocol) with a maximum score of 4 if the protocols included all sections. In their review, 13.6% scored a 0 and 63.6% scored a 2 or less (38). Reiman et al. reviewed 35 publications- they found none of the included studies reported criteria to assess readiness to return to play other *than time from surgery*. (39) Similarly, Chona et al. reported *"no studies included in this review measured return to play based on the achievement by athletes of sport-specific performance metrics equivalent to their preoperative level."* (65)

Return to Play (RTP) Criteria (cont'd)

The return to sport testing criteria at each phase progression was derived from the collection of systematic reviews and RCTs as referenced below. Only tests that were reported in 2 or more studies from different authors, have been reliably reproduced in other studies, and were deemed practically reproducible in a clinical setting were included in the return to sport testing criteria. For example, hand-held dynamometer (HHD) testing for the hip has been reliably demonstrated (68-69) and was used in three studies though two of the three were from the same group (44,8,46). Correlations between isolated strength testing and functional testing such as the side plank test and single leg hop for distance have also been established as reliable and reproducible clinical assessments on hip joint function. (69) Kierkegaard et al (70) showed a positive correlation with hip extension strength and patient reported outcomes (as well as persistent decreased hip extension strength in patients after surgery), the modified Hip-RSI has been demonstrated as a valid measure for psychometric assessment on readiness to play (63), and the HOS being the current outcome measure with the most “clinimetric evidence” (71). Although the RTS testing battery delineated in phase 4 is derived from various published protocols, comparative data is limited and more research is needed.

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NEVADA PHYSICAL THERAPY

Wk 0-Wk 3-4 (criteria dependent)

Phase 1	Day 1-4	Day 4-7	HEP	Day 8-14	HEP	Day 15-21	Day 22+
Stationary Bike	X	X		X	X		
Reverse Butterfly (IR)	X	X		X	X	X	
Circumduction (CW/CCW)	X	X		X			
Modified Thomas Stretch	X	X	X	X			
IR Long Axis Log Rolls (passive)	X	X		X			
Standing Hip ABD w/ IR		X	X	X	X	X	X
Terminal Knee Extensions		X	X	X	X	X	X
Quadruped Rockbacks		X	X	X	X		
Cat-Camel		X	X	X	X		
Hamstring Stretch (Long sit)		X	X	X	X		
Hip Extension Ball Roll Outs		X		X			
Standing Ham Curls		X		X	X	X	X
Sidelying Glute max Holds				X		X	X
Reverse Clams				X		X	X
Tall Kneeling (day 11)				X		X	X
Weigth Shifts (Day 11)				X		X	X
Supine Hip Flexion on Ball							X
ER w/ Hip at 45 deg							X
Clamshells							X
Prone Hip Extenson off Table							X

	HEP		HEP	Progression Criteria
Glute Sets	X		X	Glute Med Sidelying Hold x 30 sec
Quad Sets	X		X	Glute Max Hip Extension x 10
Circumduction (CW/CCW)	X		x	Single Leg Stance x 10 sec
Ankle Pumps	X		X	PROM 75% of UNINV (except flex/ER)

PRECAUTIONS: NO FLEX >90 deg; NO ABD >45 deg; Hip IR at 0 and 90 deg as tolerated; NO Hip ER/EXT

GOALS: WBAT or 50% WB by day 14; Accumulate 2 hrs per day laying on stomach; Protect capsular repair, pain <3/10

NEVADA PHYSICAL THERAPY

Wk 4-10 (criteria dependent)

PRECAUTIONS: No sidelying hip ABD until 6 weeks, minimize active hip flexion until 6 weeks, Begin step ups 4 wks post-op, Begin squat skill at wk 6.

Phase 2	1.0	2.0	HEP
Stationary Bike	X	X	X
Gait Drills	X		
Tall Kneel Progressions	X		
TRX Squats/Shuttle	X		
2 Way Glider	X		
Bird Dogs	X	X	
Sidelying External Rotations	X	X	X
Bridge Progressions	X	X	
Single Leg RDL Progressions (BW)		x	
Reverse Lunge		X	
Resisted Stool Rotations (IE/ER)		X	
Reverse Sled (low resistance)		X	
Hip Hinge (bodyweight)		X	
Partial Sit-Ups		X	
Modified Side Plank		X	X
Modified Front Plank		X	X
Hip Hikers		X	
Bodyweight Squats		X	

HEP For Duration of Phase 2	
Faber Slides	X
Standing Hip ABD with IR	X
Standing Calf/Soleus Stretch	X
Prone Quad Stretch	X
Bent Knee Fallouts	X
Thomas Stretch	X
Seated V Stretch	X
Seated Hamstring Toe Reach	X
Standing ITB Stretch (wk 8)	X
Standing Adductor Stretch	X
Progression Criteria	
Front and Side Plank x 30 sec	
Y-Balance <8 cm deficit all planes	
IR/ER Strength >80% UNINV	
Hip Flexor Strength >50% UNINV	
PROM WNL of UNINV (except flex/ER)	
Double Leg Squat x 25 reps	

Progress to Phase 2.2 Once mastery of Phase 2.1 exercise demonstrated.

Common Pitfalls include progressing volume to quickly, overuse of hip flexor and TFL, and aggressive stretching of hip complex reproducing groin pain or "pinching".

GOALS: Wean off crutches between day 21-35, Normalize IND gait by 6 weeks or sooner, Normal single limb stance, Full PROM

NEVADA PHYSICAL THERAPY

Wk 16+ (RTS criteria dependent)

Phase 4	D1	D2	D3	HEP For Duration of Phase 3	
Warm-Up/Movement Prep	X	X	X	Faber Slides	X
A1) BB Back Squat	X			Bent Knee Fallouts	X
B1) 1L RDL	X			Seated V Stretch	X
B2) Copenhagens	X			Seated Hamstring Toe Reach	X
B3) Reverse Nordics	X			1/2 Kneeling Psoas Stretch	X
C) Front Planks	X			Standing ITB Stretch	X
A1) BB Deadlift		X		Glute Stretch	X
B1) Nordic HS Curls		X		Hip Series	X
B2) RFE Split Squat		X		**RTS Criteria**	
B3) Resisted Hip Flexion		X		>90% HHD Strength All Planes	
C1) Glute Med Side Plank		X		Y-Balance <4 cm deficit all planes	
A1) Barbell Bridge			X	1L Broad Jump >90% UNINV	
B1) 1L Hip Thrusters			X	1L DVJ from 12" Box Vertical Jump >90%	
B2) 1L Squats/Lateral Step Downs (12")			X	Vail Hip Sport Test (Lateral) >85 reps or 4pts	
B3) Tri-Planar Lunges			X	5-10-5 Agility Drill to Standard	
C) Side Plank w/Hip ABD (reps)			X	Hip-RSI >80%, HOS SPORT >78%, HOS ADL > 96%	

Warm Up for Strength Days:
Scorpion Stretch
Inch Worm
Standing Knee to Opposite Shldr
Standing Alternating FABER
Standing Knee To Chest

Order of Programming
Warm up
Skill/Run Work
Strength
Mobility Cool Down

Skill Block 2	
Phase 1	Banded Skater Hop
Phase 2	Bounding Drill
Phase 3	1L Hurdles
Phase 4	Unanticipated Jump Skill
Speed Development Block	
Phase 1	Banded Running Drills
Phase 2	Lean Starts
Phase 3	5-10-5 Pro Agility
Phase 4	Sled Sprints

Athletes at this point should be completing 2 days per week of higher intensity, low impact cardio (rower, assault bike, ropes, etc) tabata style (20/10, 40/20 work-rest) for up to 20 minutes starting at 4-8 minute rounds

Athletes at this point should be completing the return to running program AND completing 2 days per week of zone 2 cardio with a goal duration at least 60 min, starting with 20 min rounds.

May need to add additional single-joint isolation work during this block dependent on interim strength testing.

NEVADA PHYSICAL THERAPY

Wk 9-16 (criteria dependent)

PRECAUTIONS: Monitor for groin or anterior hip pain, scale movement to minimize symptoms

Phase 3	1.0	2.0	3.0
Y-Balance Drills	X	X	
1L Elevated Bridge	X	X	
Lateral Agilities	X	X	X
Reverse Sled Drags	X	X	X
KB or BB Back Squat	X	X	X
KB or BB RDLs	X	X	X
TRX Assisted SL Squat to Box		X	
KB Step Up		X	X
Cossack/Lateral Lunge		X	X
TRX or Ball HS Curls		X	X
Standing SL Rotations w/ band		X	X
Single Leg RDL (See Progression)			X
1L Hip Thrusters			X
Single Leg Squat (See Progression)			X
Tri-Planar Lunges			X

HEP For Duration of Phase 3	
Faber Slides	X
Bent Knee Fallouts	X
Seated V Stretch	X
Seated Hamstring Toe Reach	X
1/2 Kneeling Psoas Stretch	X
Standing ITB Stretch	X
Glute Stretch	X
Hip Series	X
Progression Criteria	
Hip Flexor Strength >80% UNINV	
Y-Balance <4 cm deficit all planes	
IR/ER Strength >80% UNINV	
Hip Flexor Strength >50% UNINV	
PROM WNL of UNINV (except flex/ER)	
Double Leg Squat x 25 reps	

Warm Up for Strength Days:
Scorpion Stretch
Inch Worm
Standing Knee to Opposite Shldr
Standing Alternating FABER
Standing Knee To Chest

Hip Series (3-4x per week):
Prone Hip Ext. x 20
Bird Dogs x 20
2L Bridge x 20
1L Bridge x 20

Single Leg RDL Progression	
Phase 1	Weight Shift to SL w/ trunk Lean
Phase 2	Assisted SL RDL (bodyweight)
Phase 3	Bodyweight SL RDL
Phase 4	Loaded SL RDL

Single Leg Squat Progression:	
Phase 1	TRX Assisted to Box
Phase 2	Eccentric (1 down, 2 Up) to Box
Phase 3	Bodyweight SL Squat to Box
Phase 4	Loaded Single Leg Squat

Athletes/patients should have established ability to reproduce program independently outside of the clinic by this phase.

GOALS: Complete 6" anterior step down without compensation, able to complete squat and bilateral lunge work without hip pain, begin intensity progressions with no complaint

Phase 1 Sport Skill Development (Wk 14+)	
Skater Hop Decel	Skater Hop
Drop Catch, 2L to 1L	DVJ
1L to 2L Broad Jump	1L to 1L Broad Jump
Lateral 1L Box Jump	1L to 1L Lateral Box Jump