Hip Arthroscopy - State of the Art in 2018

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Abstract: The field of hip arthroscopy has undergone considerable change in the past 25 years and continues to evolve at a rapid pace. Lessons from the early complications and challenges of hip arthroscopy have led to improved safety and refinement of instrumentation and techniques. The pathophysiology of hip injuries is better understood, and advances in surgical technique have helped expand indications, particularly as a shift from pathology resection to anatomic repair and reconstructive procedures has occurred. As the field has progressed, longitudinal outcome studies are now available to help judge efficacy. The purpose of this review is to highlight the past 30 years of hip arthroscopy, the current practice trends, and future directions of the field.

Key Words: hip, arthroscopy, femoroacetabular impingement, history, review, outcomes

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WHERE WE WERE 30 YEARS AGO

Michael Burman[1] performed the first recorded hip arthroscopy on cadaveric specimens in 1931. In his study, he described the utility of arthroscopy for several joints, but regarding the hip he declared that it is "manifestly impossible to insert a needle between the head of the femur and acetabulum." The field grew slowly, and literature describing any clinical application for arthroscopic hip surgery appear only by Takagi[2] in the late 1930s for infection or neuropathic arthropathy and later by Gross[3] in the 1970s for diagnosis of pediatric hip conditions. These clinical applications were utilized as adjunctive tools, did not replace open surgical approaches, and were mostly limited to peripheral compartment work because of the difficulty of central compartment access and visualization without traction.

Beginning as recently as the late 1970s, the field began to expand. During this time, pioneers of modern-day hip arthroscopy refined basic set-up and technique to allow for current practice. The value of joint distraction was recognized, and in 1986, Eriksson et al[4] showed that adequate visualization of the entire hip joint required 300 to 500 Newtons of force in an anesthetized patient. In some early reports, young, muscular, and large patients continued to present challenges to distraction and joint access with standard supine technique in nearly 40% of cases.[5] Therefore, in 1987 Glick and Sampson described hip arthroscopy in the lateral decubitus position with skin traction.[5,6] Dr. Glick later designed the first hip arthroscopy specific distractor (Arthronix), compatible with the lateral position. As the lateral technique was further refined, he published on the diagnosis and treatment of central compartment pathology in 1991.[7] Around the same time, Byrd[8] described modifications to the supine technique to improve safe access and visualization. Some of his important contributions include portal placement and technique. He described the relevant neurovascular anatomy, the use of tactile sensation and fluoroscopy to avoid iatrogenic damage to the cartilage and labrum upon entry into the joint, and is credited as the first to design and utilize a 70-degree hip arthroscope.[9,10]

As technical refinement allowed safer and more reliable joint access, the utilization of hip arthroscopy began to grow. In 1992, Dr Richard Villar convened the first hip arthroscopy seminar in England to facilitate collaboration among peers, inviting Drs Glick, Byrd, Eriksson, and Joseph McCarthy.[11] Later that year, Dr Villar published the first hip arthroscopy textbook.[12] Between 1995 and 1998, Dr Byrd and colleagues developed a hip arthroscopy study group that met at the annual Arthroscopy Association of North America (AANA) meeting. These early groups were instrumental in the development of research questions and spread of ideas. As these questions were systematically investigated and answered, the pathophysiology of hip injuries became better understood.

Diagnostic arthroscopy and arthroscopic removal of loose bodies in the hip joint following trauma remained the most common clinical applications for hip arthroscopy even in the early 1990s.[13] As the utilization of hip arthroscopy continued to expand, the recognition of patterns of alternate sources of hip pain began to emerge. With advanced imaging modalities (MRI/MRA) still in their infancy, however, the diagnosis of soft-tissue causes of hip pain remained elusive. In 1996, Byrd[14] published a series of three patients he diagnosed and treated with labral lesions as a primary source of mechanical hip pain. He utilized a fluoroscopically guided intra-articular anesthetic injection as his primary diagnostic tool, and treated each patient with hip arthroscopy and labral resection with good reported pain relief. In 2001 he published a larger clinical series of 42 athletes that underwent hip arthroscopy for diverse soft-tissue pathologies of the hip, including occult labral and chondral injuries, as well as ligamentum teres ruptures.[15] In 2003, Ganz et al[16] published a landmark study, suggesting femoracetabular impingement (FAI) as a cause for idiopathic hip arthritis. His study resulted from an earlier observation that some patients developed early degeneration of their hip following periacetabular osteotomy (PAO) to treat hip dysplasia. The increased anterior and lateral reorientation of the acetabulum resulted in femoral head "over-coverage" and resultant impingement between the anterolateral neck of the femur and the "new" rim during physiologic motion. The repetitive impingement resulted in labral and cartilage injury, and possibly early osteoarthritis. This same anatomic pattern was then identified in patients with hip pain and early degeneration without previous surgery. Professor Ganz proposed that surgical treatment of FAI should focus on improving the clearance for hip motion and alleviation of femoral abutment against the acetabular

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rim, which may decelerate the progression of hip degeneration. Surgeons and researchers now shifted their focus to treating this underlying etiology in addition to addressing the labral/chondral damage FAI caused. Biomechanical studies emerged showing the importance of the labrum to hip stability and distribution of joint stresses during loading,[17,18] and Philippon et al[19] showed that repaired labral tissue had the capacity to heal, demonstrating histologic confirmation in an ovine model. With improved understanding and instrumentation, early debridement procedures evolved into restorative options, repairing the labrum when possible and reshaping the bone to correct FAI.

WHERE WE ARE TODAY

With a generally accepted framework to diagnose and treat pathologic intra-articular hip conditions such as FAI and labral tears, the number of surgeons performing hip arthroscopy and the number of procedures quickly expanded. Over a 5-year period from 2006 to 2010, the number of reported hip arthroscopies performed by American Board of Orthopaedic Surgery Part II examinees increased by >600%.[20] During the same time period, a corresponding increase of 500% in published studies appeared in the literature.[21] For the first time, many of these studies were able to report on large patient series, comparative groups, as well as short-term and mid-term outcomes, allowing for judgment of efficacy. When comparing labral repair versus debridement, Larson et al[22] showed statistically significant improvements in subjective patient outcome scores at 3.5 years follow-up in the repair group, and Ayeni et al[23] performed a systematic review showing labral repair resulted in better outcomes compared to labral debridement in all studies included. When comparing open and arthroscopic management for FAI, several studies have shown equivalent or better outcomes and fewer complications with arthroscopic treatment when performed by experienced surgeons.[24–26] Multiple studies have now demonstrated good short-term and mid-term outcomes with arthroscopic treatment of FAI. Philippon showed high patient satisfaction and good-to-excellent outcomes in 112 patients at 2 years follow-up, and Byrd reported prospective data on 50 patients with 10-year follow-up showing an average improvement of 25 points (preoperative 56, postoperative 81) using the modified Harris Hip Score.[27,28] Results in athletes have also demonstrated reasonably good durability. Nho and colleagues found 78% return to play at 1 year and 73% return to play at 2 years in high-level athletes following arthroscopic treatment of FAI, whereas Amenabar and O'Donnell found 33 of 34 professional Australian footballers had returned to the same level of play at 1 year.[29,30] Sansone et al[31] prospectively evaluated high-level athletes undergoing FAI surgery and found that 73% were able to return to sport, though only 52% were able to return to sports at the same competitive level, though statistically significant improvements were demonstrated in all outcomes measured (pain, symptoms, function, physical activity level, quality of life, and general health) at 12 months follow-up. Although several studies have evaluated the outcomes of hip arthroscopy in male high-level athletes, Shibata et al[32] were the first to compare clinical outcomes of male and female elite competitive athletes following hip arthroscopy. Similar rates of return to play (>85% to the same level of competition) were found between the 2 groups despite distinct differences in diagnosis. More male athletes were treated for combined-type FAI morphology, had extensive chondral rim damage, and required microfracture more commonly. Conversely, females had a higher proportion of Pincer-type FAI and instability. In both groups, however, patients who were able to return to the same level of competitive activity had a significantly shorter duration of preoperation symptoms compared to those who could not, which was found by Sansone et al.[31,32]

With the expansion of hip arthroscopy came several learning opportunities and signs for caution. The generally good-to-excellent results seen with arthroscopic treatment of FAI diminished significantly in patients with cartilage degeneration or osteoarthritis at the time of surgical management.[33,34] In 2003, Clarke et al[35] first reported on the overall complication rate of hip arthroscopy of 1.4% in 1054 cases. In 2013, a systematic review looking at more current data in over 6000 cases revealed an increasing complication rate, likely related to the increasing number of new surgeons performing the procedure. The rate of minor complications was 7.5%, with transient neuropraxia and iatrogenic chondrolabral injury occurring most commonly.[36,37] The rate of major complications was 0.58%. It is interesting to note that, Souza et al[38] showed that with experience the incidence of complications did not change, but the type of complication did; more experienced surgeons had fewer complications associated with basic technique (ie, iatrogenic chondral/labral injury), but experienced new complications associated with more advanced procedures. Some of the reported cases included femoral neck fractures, abdominal compartment syndrome, and iatrogenic instability and even hip dislocation. In a recent review of a large national payer-based database, Truntzer et al[39] found that complications after hip arthroscopy are likely significantly higher than reported in the orthopedic literature. These cases again reminded surgeons that hip pathophysiology and technique remained imperfect, and required further study. However, the difference between published series of complications by "high volume hip arthroscopy experts" is significantly less than the insurance database, suggesting that the expert papers may not be generalizable. Using intraoperative nerve monitoring, Telleria et al[40] recently demonstrated that maximum traction was a greater risk for sciatic nerve dysfunction than total traction time, contrary to long-held beliefs. Mardones and colleagues found that resection of greater than 30% of the anterolateral femoral head-neck junction significantly decreased the amount of energy required to cause a fracture, and recommended judicious use and understanding of imaging to prevent over-resection.[41] Therefore, although increasingly recognized as an effective procedure for the treatment of FAI and related hip disorders, hip arthroscopy is considered a technically challenging procedure that can result in significant complications by both experienced and inexperienced surgeons. Hip arthroscopy is now a fairly routine part of trainee education, although there is great variability in hands-on experience and the learning curve has often been described as "steep," though it remains ill-defined. A systematic review by Hoppe et al[37] found that when 30 cases were used an arbitrary cut-off between early and late cases, there was a significant reduction in both complications and operative time. Mehta and colleagues, however, utilized reoperation rate as a surrogate for proficiency. They found that career volume was associated with reoperation rate, and that four strata of surgeon career volume were associated with significantly different risk profiles. Surgeons in the lowest volume stratum (0 to 97 cases) had the highest frequency of additional surgery (15.4%) compared those in the middle (13.8%), high (10.1%), and highest (2.6%) strata. Surgeons with hip-specific fellowships reached the lowest statistically significant risk of additional surgery at 98 career cases, whereas surgeons without fellowship training did not reach the same benchmark until 389 cases.[42]

With improved instrumentation, new techniques, and more specialists performing and teaching hip arthroscopy the continued growth of the field is expected. In 1990s, the indications for hip arthroscopy were primarily limited to diagnostic use, loose body removal, and labral debridement. Over the course of the past 30 years, the applications of hip arthroscopy have dramatically expanded (See Table 1). Procedures that were previously performed by open methods are being attempted and refined arthroscopically/endoscopically, including a variety of extra-articular pathologies such as abductor and proximal hamstring repairs, iliopsoas lengthening, and sciatic nerve exploration and release. Techniques have been developed to address labral deficiency, including both autograft and allograft reconstruction, with promising short-term outcomes. Geyer and colleagues prospectively reported outcomes of arthroscopic labral reconstruction using an iliotibial band autograft showing survivorship of 76% at 3 years with high patient satisfaction and statistically significant improvement in function. Joint space <2 mm was a poor prognostic factor for survival of the hip as 25% of patients in the study progressed to total hip arthroplasty at an average of 28 months.[43] In elite athletes, Boykin et al[44] showed 81% were able to return to play following labral reconstruction in short-term follow-up. Compared with labral repair, Matsuda et al[45] showed equivalent outcomes with labral reconstruction in a small series.[44] A systematic review by Ayeni et al[46] concluded that although short-term outcomes of labral reconstruction appear to demonstrate functional improvement, long-term, higher-quality studies are needed to confirm the benefits of the procedure and refine indications, as proper patient selection remains ill-defined. As the field pushes forward, this continues to be a common trend as innovation can often outpace the time required to obtain outcomes and judge efficacy.

TABLE 1. Modern Applications of Hip Arthroscopy

Applications of Hip Arthroscopy
Diagnostic
Loose body removal
Chondral injury (microfracture, ACT, AMIC, direct repair)
Labral injury (resection, repair, reconstruction)
FAI (acetabuloplasty, femoroplasty/femoral osteoplasty/ chielectomy)
Internal snapping hip
Greater trochanteric pain syndrome
External snapping hip
Hip instability (capsular plication and capsular reconstruction)
Subspinous impingement
Gluteus medius tears
Ischiofemoral impingement
Ligamentum teres ruptures (debridement and reconstruction)
Fracture fixation (femoral head and acetabulum)
Sciatic nerve entrapment (fibrous bands, piriformis syndrome)
Proximal hamstring injuries
Pubic symphyseal pain
Benign tumors (osteochondroma, osteoid osteoma, pigmented villonodular synovitis PVNS, synovial chondromatosis, synovial osteochondromatosis

WHERE WE WILL BE IN THE FUTURE

Nevertheless, the future of the field is bright. More high-quality studies continue to appear and enhance the understanding of hip anatomy and pathology. Telleria et al[47] recently described the normal anatomic location of the hip capsular ligaments and their relationship to routine portals used during arthroscopy. This capsuloligamentous complex (CLC), particularly the iliofemoral ligament has been shown to be an important contributor to hip stability, serving as a static soft-tissue restraint to anterior subluxation of the femoral head during adduction and extension.[48] Emerging concepts of "microinstability" of the hip build upon these principles and suggest that certain athletes can present with symptomatic instability due to attenuation of the CLC because of repetitive microtrauma, even in the presence of normal bony morphology. Short-term results of capsular plication for this subset of patients are encouraging, though there is lack of standardized criteria for diagnosis.[49] Chondral injury continues to be at the forefront of joint preservation efforts. Autologous chondrocyte transplantation (ACT), autologous matrix-induced chondrogenesis (AMIC), and direct chondral repair have all been studied but in small series with short-term follow-up.[50–53] Biologics and other stem-cell therapy trials are currently underway to treat chondral injury. Novel imaging sequences are being studied to detect early cartilage injury. Serum markers such as C-reactive protein and cartilage oligomeric matrix protein (COMP) are known to be elevated in male athletes with FAI, and synovial fluid cytokine and fibronectin-aggrecan complex (FAC) were identified as elevated in patients with hip chondral injury without radiographic OA.[54,55] These advancements in detection offer clinicians a possible opportunity to identify at-risk patients, further refine surgical indications, and potentially intervene early in the disease process. Long-term outcomes for FAI surgery, including other less common forms of impingement (ischiofemoral, subspine), will be available soon and shed light on the efficacy and durability of the procedure. Computer-navigated FAI surgery is being investigated to assist in preoperative planning and intraoperative guidance.

The field of hip arthroscopy has changed tremendously in the past 30 years. In a short time, it has progressed from an adjunctive tool with clinical applications limited to diagnosis and pathology resection to safe, anatomic reconstructive procedures. FAI was first described <15 years ago and is now the most common clinical indication for hip arthroscopy. However promising, the innovation of the field at times has outpaced the data necessary to support its efficacy. Hip arthroscopy is a technically challenging procedure, and the most common complication remains iatrogenic chondral/labral injury. Although this should give surgeons pause, the field is also exciting, and the future is unarguably bright. There remains multiple opportunities for discovery, particularly in the detection and treatment of chondral injury. If the pace of the last 30 years is any indication, the next 30 years should answer many fundamental and puzzling questions about hip disorders, as well as continue to provide novel strategies for treatment.

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