

Prospective Analysis of Hip Arthroscopy With 2-Year Follow-up

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Purpose: Numerous indications, but little outcome data, have been reported for hip arthroscopy. The purpose of this prospective study is to report the 2-year results of hip arthroscopy performed on a consecutive series of patients for a variety of disorders. **Type of Study:** Case series. **Materials and Methods:** There were 38 procedures performed on 35 patients who have achieved 2-year follow-up. All patients were assessed with a modified Harris hip score (pain and function) preoperatively and postoperatively at 1, 3, 6, 12, and 24 months or until a subsequent procedure was performed. Variables studied included age, sex, diagnosis, duration of symptoms, onset of symptoms, center-edge angle, Workers' Compensation, and pending litigation. **Results:** Follow-up was obtained on all patients. The median score improved from 57 to 85 points. This included 10 cases (9 patients) who underwent a subsequent procedure at an average of 10 months (6 total hip arthroplasty, 1 core decompression, 3 second arthroscopy) with an index score of 54 compared with 52 at the time of the second procedure. The median improvement for the following diagnoses was: loose body (34), labral lesion (27), synovitis (26), chondral injury (18), arthritis (14), and avascular necrosis (–11). Of the variables studied, the most statistically significant finding was that older men with longer duration of symptoms did worse. Two complications occurred in 1 patient: partial neuropraxia of the lateral femoral cutaneous nerve and focal myositis ossificans along the anterior portal tract. **Conclusions:** Hip arthroscopy can be performed for a variety of conditions (except end-stage avascular necrosis) with reasonable expectations of success and an acceptable complication rate. This is the first report to quantitate the results of hip arthroscopy for a heterogeneous population. **Key Words:** Hip arthroscopy—Outcomes—Supine—Results.

Arthroscopic surgery of the hip is a well-established technique. The indications have been well formulated for both diagnostic and interventional purposes.^{1,2} These indications do continue to evolve as both skills and technology mature. The basic principles for carrying out the technique have been defined.³⁻⁷ Modest variations exist depending on whether the procedure is performed in the supine or the lateral position, and arthroscopy has even been reported without distraction of the joint.

Despite the accepted nature of arthroscopy and the growing amount of literature to support the indications, there have been few data reported on the results of the procedure. Most articles provide anecdotal information or case reports, or define only a small subset of the population. This is the first report to quantitate the results of hip arthroscopy in a consecutive series of patients for a heterogeneous group of indications.

MATERIALS AND METHODS

In March 1993, the authors began tracking all patients undergoing hip arthroscopy. As of December 1997, data on 121 consecutive cases had been gathered. All procedures were performed supine using distraction on a modified fracture table as previously reported by the senior author.^{3,4,8-10} The substance of

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TABLE 3. Diagnoses for Hip Arthroscopy

Arthritic disorders	Synovitis
Rheumatoid arthritis	Etiology: rheumatoid arthritis, synovial chondromatosis, gout; calcium pyrophosphate disease (inflammatory), chemical induced, idiopathic, traumatic, pigmented villonodular synovitis, other
Inflammatory arthritis	Pattern: focal (pulvinar), diffuse
Osteoarthritis: primary, secondary to inverted labrum, post-traumatic, secondary to synovial chondromatosis, secondary to Perthes disease, secondary to dysplasia, secondary to slipped capital femoral epiphysis	Ligamentum teres damage
Gout	Complete rupture
Calcium pyrophosphate disease	Partial rupture
Other	Degenerate ligament
Dysplastic disease of the hip (CE angle <20°)	Chondral damage
Borderline dysplastic disease of the hip (CE angle 20°-25°)	Acute traumatic
Perthes disease	Chronic traumatic
Avascular necrosis of the femoral head	Arthritic
Stage: I, II, III, IV, V, VI	Grade: I, II, III, IV
Articular surface: intact, fragmented	Location: femoral head, acetabulum, femoral head and acetabulum
Synovial chondromatosis	Labral pathology
Sepsis	Etiology: traumatic, degenerative, idiopathic, congenital, acetabular dysplasia
Total hip replacement	Morphology: radial flap, radial fibrillated, peripheral longitudinal, inverted, unstable
Free fragments	Location: anterior, posterior, lateral, anterolateral
Inflammatory process	Osteochondritis dissecans
Fibrosis	Grade: stable—intact articular surface, fragmented articular surface; unstable
Soft tissue impingement	Post-traumatic
Infection	Perthes disease
Loosening: acetabular component, femoral component, both components	Idiopathic
Loose bodies	Fibrosis
Post-traumatic	With limited range of motion
Avascular necrosis	Without limited range of motion
Synovial chondromatosis	Osteophyte
Foreign body	Impinging
Osteochondritis dissecans	Not impinging
Other	

as follows: *traumatic* involved a major injury such as an auto accident, fall from height, hip dislocation; *acute* signified a twisting episode or other well-defined event precipitating the acute onset of symptoms; and *insidious* meant that there was no injury or precipitating event, but simply the gradual onset of worsening symptoms. The center-edge (CE) angle was recorded on the anteroposterior radiograph in all cases. If it was a Workers' Compensation case or if there was pending litigation, this was noted. Complications were also recorded.

Statistical Methods

To estimate the overall change in score at 24 months for the entire group, dropouts were assigned a score lower than the minimum score of those who had a complete 24-month follow-up and the median score was used as the measure of central tendency of the

score and change from baseline. The change in score from baseline for those who had complete follow-up was adjusted for baseline score [$100 \times \Delta$ in score / (100 - Baseline Score)] and compared with patient factors using linear regression analysis. Exploratory graphic analysis was used to justify the use of linear regression. This led to using a log transformation of durations of symptoms in the regression analysis because of the distribution of this value. A factor was considered related to the change in score if the coefficient in the regression analysis was significantly ($P < .05$) different than zero.

Univariate analysis of the relation of dropout status and patient factors was performed using the Fisher exact test for categorical variables and *t* tests for continuous variables. Multiple variable analysis was carried out using logistic regression analysis to look at combinations of factors that might predict dropout status.

RESULTS

Follow-up was achieved in 100% of patients (38 cases in 35 patients). Overall, the median score improved 28 points from a preoperative value of 57 to 85 postoperatively. These results included 10 cases (9 patients) who underwent a subsequent procedure at an average of 10 months. For this group of 10 cases, the median preoperative score was 54 compared with 52 at the time of the second procedure. Six patients underwent total hip arthroplasty: 2 for osteoarthritis, 1 for inflammatory arthritis, 1 for rheumatoid arthritis, and 2 for stage V avascular necrosis (AVN). One patient with previously documented AVN underwent arthroscopy for removal of a large loose body and subsequently underwent core decompression. One patient, after removal of loose bodies for synovial chondromatosis, developed symptoms from an area of myositis ossificans along the anterior portal tract. At the time of excision of this mass, second-look arthroscopy was performed to rule out recurrent intra-articular disease. One patient underwent 2 subsequent arthroscopic procedures for recurrent intra-articular symptoms.

Demographics

Among the 38 procedures were 20 left and 18 right hips. Of the 35 patients, 18 were male and 17 were female; the average age was 38 years (range, 15 to 84 years). The diagnoses are listed in Table 4. The duration of symptoms ranged from 1 to 156 months with an average of 21 months. The onset was traumatic in 7 cases, acute in 15, and insidious in 16 cases. The CE angle ranged from 19° to 48° with an average of 32°. Four cases involved Workers' Compensation claims and 4 cases had pending litigation.

Statistical Results

The median scores for all procedures are outlined in Fig 1. The change in score over 24 months for those

TABLE 4. Diagnoses for Hip Arthroscopy

Labral pathology (23)
Chondral damage (15)
Arthritic disorder (9)
Synovitis (9)
Loose bodies (6)
Avascular necrosis (4)
Perthes disease (2)
Synovial chondromatosis (1)
Ligamentum teres damage (1)

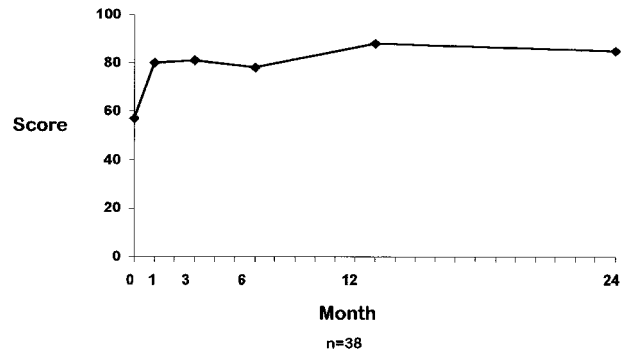


FIGURE 1. The graph plots the median score over the period of the study.

who had complete follow-up was significantly related to their baseline score (Fig 2). The lower the baseline score, the higher the change in score. There was no significant difference in the overall change in score adjusted for baseline between male and female patients.

For female patients, there was no significant relationship between change in score adjusted for baseline and any other factor. There was a mild decreasing trend with respect to duration of symptoms ($P = .08$).

For male patients, there was a significant relationship between age and change in score adjusted for baseline ($P = .03$) and, if 1 outlier were removed, this relationship was quite strong ($P = .002$) (Fig 3). There was also an interaction between age and duration of symptoms ($P = .04$), indicating that the smallest increase in scores occurred for older men with longer duration of symptoms.

Among the 38 procedures, 10 patients (26%) dropped out before completion of the 24-month period. The general time course of those followed-up to

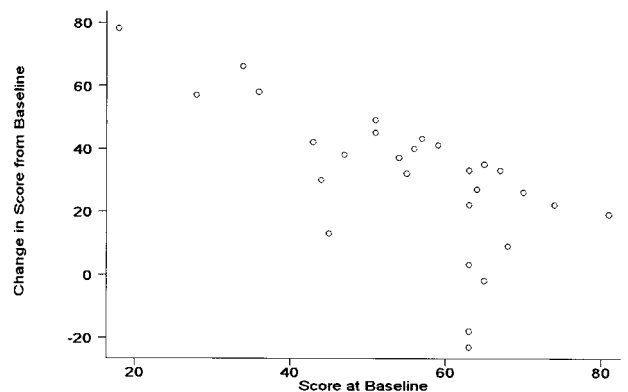


FIGURE 2. An inverse linear relationship is noted between the change in score from baseline and the baseline score.

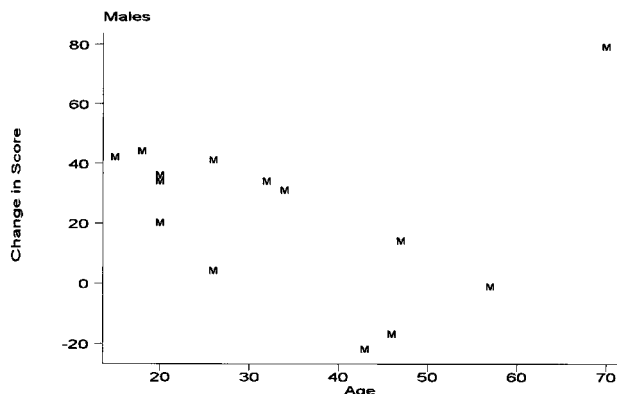


FIGURE 3. The relationship is plotted for male patients of the change in score adjusted for baseline with age.

completion and those who dropped out is shown in Figs 4 and 5. Dropout status was not related to any patient factor.

Observations

Results for the most common diagnoses are outlined in Fig 6. To summarize, the median improvement for the following diagnoses were: loose body (34), labral lesion (27), synovitis (26), chondral injury (18), arthritis (14), and AVN (-11). Labral lesions were also subcategorized as isolated lesions or occurring in conjunction with accompanying chondral damage (Fig 7).

The results based on onset of symptoms are detailed in Fig 8. While the traumatic group seemed to fare much better than the acute, which was slightly better

than the insidious group, these differences were not statistically significant.

Results based on whether it was a Workers' Compensation case or whether there was pending litigation are shown in Fig 9. Although both of these groups seemed to respond much better than the group that did not involve Workers' Compensation or pending litigation, these findings, again, were not statistically significant. There was no correlation of results with CE angle and no trend was noted (Fig 10).

Complications

Two complications occurred in 1 patient who underwent removal of multiple loose bodies associated with synovial chondromatosis. Most of the loose bodies were removed with a grasper introduced along the anterior portal tract. Postoperatively, the patient had partial neuropraxia of the lateral femoral cutaneous nerve characterized by a small patchy area of reduced sensation in the lateral aspect of the thigh. He also subsequently developed a focal area of myositis ossificans within the portal tract. There was some local irritation from the palpable bony mass because the patient was quite thin. He later underwent an uneventful excision of the mass as well as a second-look arthroscopy to rule out recurrent disease.

DISCUSSION

For group analysis purposes, use of the median score was selected because it most accurately reflected the patient groups, incorporating those patients who

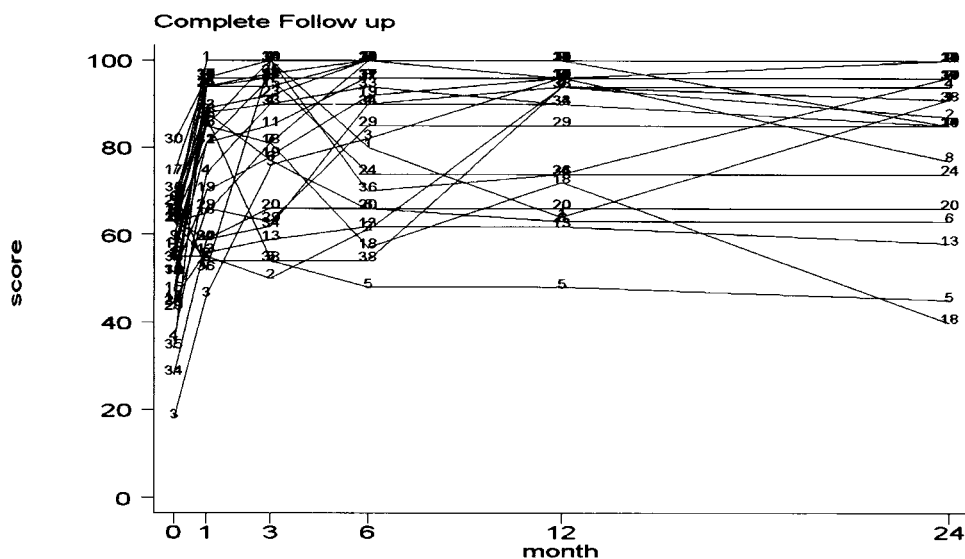
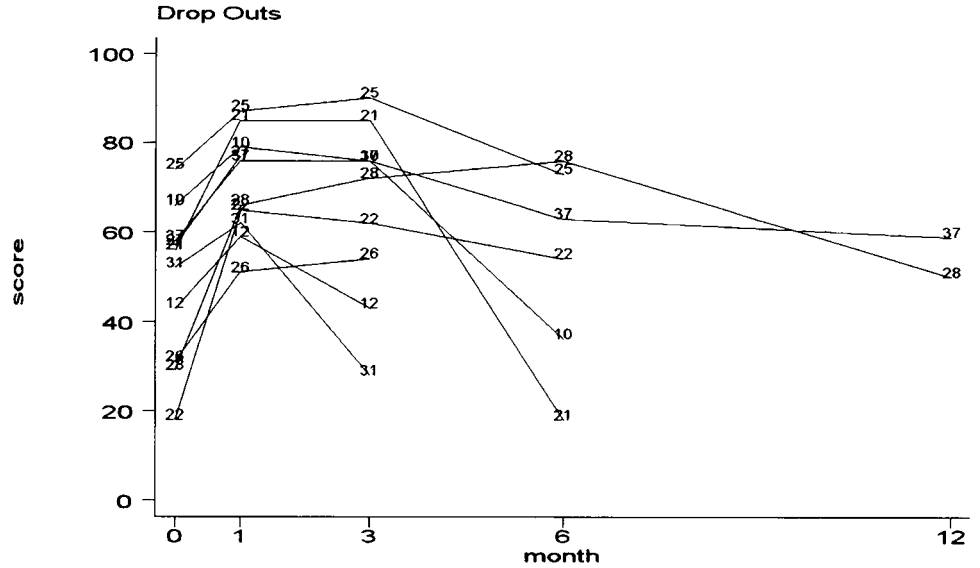


FIGURE 4. The individual scores are plotted for those cases followed to completion. The numbers on the plot lines correspond with the patients' ID numbers.

FIGURE 5. The individual scores are plotted for those patients who underwent a subsequent procedure. The numbers on the plot lines correspond with the patients' ID numbers.



dropped out during the 24-month period. To delete these cases from the study at the time they dropped out would have artificially made the subsequent results appear better over the period of the study. Thus, by assuming that the result of a patient in the drop-out group would be lower than the lowest score for those who completed the study, the median score provided a fair and accurate assessment.

As noted in the results, there was a significant correlation between the amount of improvement and the patient's baseline score. Specifically, the lower the baseline score, the higher the change in score. This simply reflects that the better the patient's preoperative score, the less room there was for improvement. Thus, the score adjusted for baseline was used $[100 * \Delta \text{ in score} / (100 - \text{Baseline Score})]$ for statistical analysis. This basically reflects the percentage of improvement. However, for clinical reporting purposes, this is a busy

formula and thus only the modified Harris hip score is used for reporting clinical results.

The Harris hip rating system is an imperfect instrument for use in this population because the system was designed to assess hip arthroplasty. Nonetheless, it is a recognized and accepted method of quantitating subjective measurements. The group can be roughly classified using Harris' original scheme (90-100 excellent, 80-90 good, 70-80 fair, below 70 poor). Overall, for the group completing 2-year follow-up (n = 28), the preoperative rating included 25 poor, 2 fair, and 1 good, compared with postoperative results of 5 poor, 2 fair, 5 good, and 16 excellent results. For those

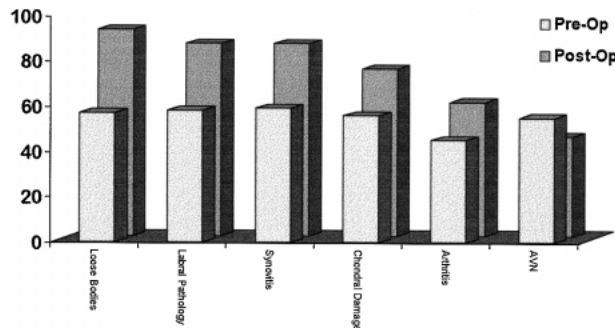


FIGURE 6. Results are plotted for specific diagnoses.

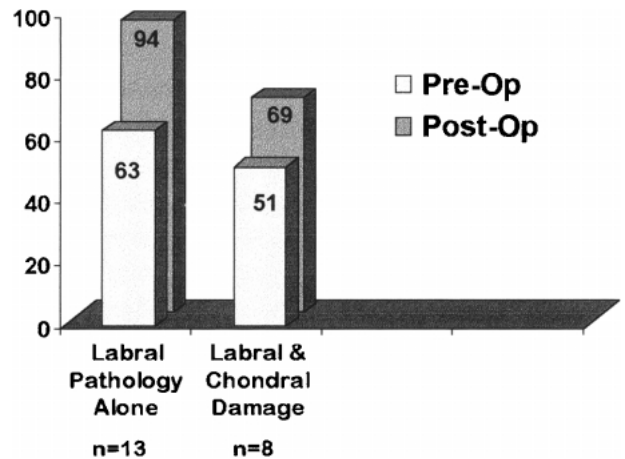


FIGURE 7. Results for labral pathology are subcategorized for isolated labral damage and cases with labral and chondral damage.

Onset

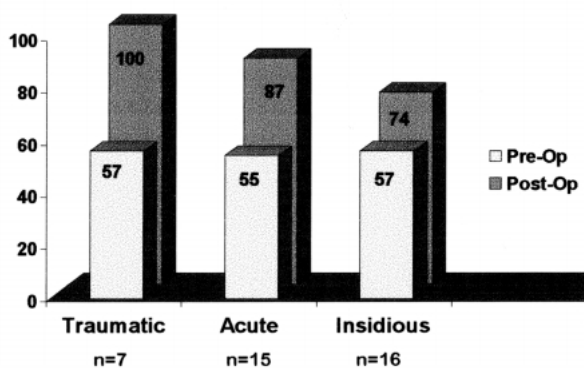


FIGURE 8. Results are defined based on the onset of symptoms.

patients who dropped out (n = 10), there were 9 good and 1 poor preoperative ratings compared with 8 poor and 2 good postoperative ratings at the time of drop out.

For the diagnosis-based classification, the number of cases is too small and the categories too numerous to determine statistical differences between the groups. However, knowledge of the results for a given diagnosis aids the surgeon in counseling patients on the projected response to arthroscopic intervention. The classification scheme presented here (Table 3) distinguishes major groups as well as detailed sub-groups. While the numbers presently are small, it is felt that this system will be useful in the future for further defining the clinical relevance of diagnosis-based results.

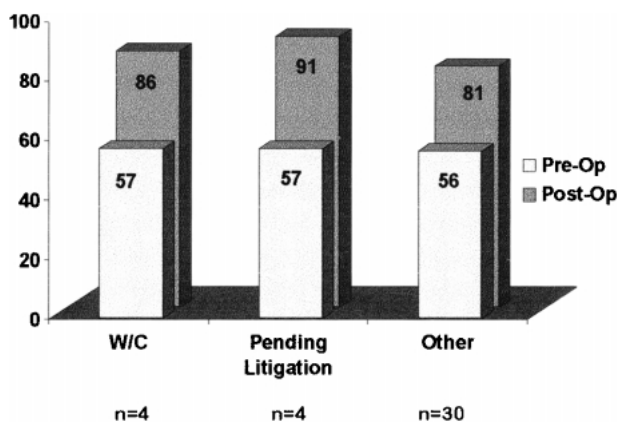


FIGURE 9. Results are distinguished based on whether Workers' Compensation was involved or litigation was pending.

CE Angle

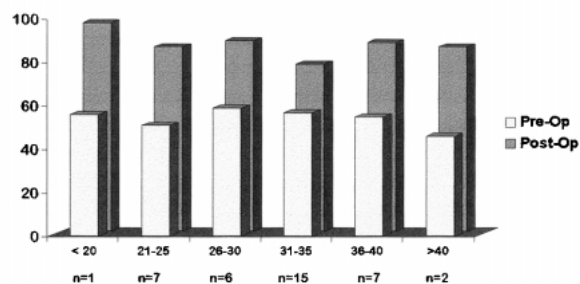


FIGURE 10. Results are subcategorized based on the CE angle.

Loose Bodies

Removal of symptomatic loose bodies is recognized to be one of the most gratifying of all arthroscopic procedures. Its role in the hip has been previously documented in the literature and is supported by the results of this study with the greatest symptomatic improvement (34 points).^{1,2,11,12}

Labral Lesions

Arthroscopic resection (partial labrectomy) for labral pathology also resulted in symptomatic improvement (27 points). Labral debridement in the presence of arthritic changes has previously been noted to be associated with poorer outcomes and this is why labral lesions were subcategorized as isolated lesions or occurring in conjunction with accompanying chondral damage. Isolated lesions did better (31 points) than those with associated articular surface injury (18 points). Although these differences may not have been statistically significant, the observation is certainly consistent with those of previous investigators regarding poorer outcomes with accompanying chondral damage.¹³

Synovitis

Arthroscopic debridement was performed for synovial disease and for synovial disease with coexisting intra-articular pathology. For the group, significant symptomatic improvement was noted (26 points), reflecting that arthroscopy does have a place in the treatment of synovial disease of the hip as it has been documented for other joints. It should be noted that this was a diverse group, including 2 cases each of rheumatoid arthritis, chemically induced synovitis, inflammatory synovitis, and traumatic synovitis, and 1 case of synovial chondromatosis.

Chondral Injury

Patients with chondral injury, as a group, showed an overall improvement of 18 points. This included a spectrum of pathology from acute isolated fractures of the articular surface to diffuse erosive lesions from degenerative disease. The numbers are still too small for subclassification to be of use, but over time, it may provide a better predictive index for defining response to treatment.

Arthritis

Arthritis is not an arthroscopic diagnosis. It does not define the extent of articular surface damage, the status of the synovium, or accompanying degenerative changes to either the labrum or ligamentum teres. Nonetheless, the question is often asked, "How do patients with arthritis do?" Consequently, arthritis as a category has been included. It is redundant and overlaps with other categories but is an accurate clinical classification. Arthroscopic debridement for arthritis showed a modest response with an overall improvement of 14 points.

AVN

Four patients with AVN of the femoral head underwent arthroscopy. Three of these had stage V disease and underwent arthroscopy as a palliative procedure to try to postpone consideration of total hip arthroplasty. The results were poor: 2 patients subsequently went on to hip replacement within 5 months, and 1 is living with his symptoms, although they have worsened over time (−18 points at 2-year follow-up). A fourth patient with stage II AVN underwent removal of an accompanying loose body with symptomatic improvement of 20 points, although she subsequently underwent core decompression to address the lesion in her femoral head.

Consequently, in the authors' opinion, arthroscopy as a palliative procedure for end-stage AVN is contraindicated. However, AVN itself is not necessarily a contraindication to arthroscopy. Other reports support the role of arthroscopy, both as a staging procedure and as a method of addressing coexistent intra-articular pathology for patients being considered for procedures to revascularize the femoral head.¹⁴

Onset of Symptoms

Patients with traumatic onset of symptoms seemed to do best, and those with acute onset did better than those with insidious onset. Although the differences

were not statistically significant, it is wise for the surgeon to keep in mind that patients with a gradual onset of symptoms and no precipitating event may not fare as well in their response to surgery. Certainly, a traumatic or acute event does not assure a good outcome, nor does an insidious onset preclude a good result.

We postulate that, with a major traumatic event, the patient is likely to have had an otherwise healthy joint. Thus, arthroscopic treatment of a traumatic lesion may result in more predictable symptomatic improvement. Conversely, gradual onset of symptoms in the absence of an injury suggests either a degenerative process, or some other inherent predisposition to intra-articular pathology, and a less predictable response. Intermediate between the 2 is the onset of symptoms resulting from an acute event such as a twisting injury. While the event may be sufficient to explain a damaged structure, the authors speculate that, for many of these individuals, the injury would have been less likely to occur in an otherwise healthy joint.

Age

While there was no significance with relationship to age among the female patients, 1 of the few corollaries was noted among male patients with increasing age. Older men showed less improvement. There was also an interaction with duration of symptoms, which is discussed below.

Duration of Symptoms

As noted, longer duration of symptoms among male patients correlated with less successful outcomes. There was also an interaction of age and duration of symptoms that was greater than could be explained solely by the additive effect of the 2 influencing factors.

This certainly suggests that chronic disorders (at least among men) may respond less reliably to arthroscopic intervention. This must still be kept in a clinical perspective for each individual patient. More recent onset of symptoms should not lower the threshold for recommending surgery, whereas long-standing duration of symptoms may not necessarily preclude a successful outcome.

It is best for the surgeon to always take a thoughtful, conservative approach to considering arthroscopic intervention of the hip. Although it is apparent that arthroscopy offers little for some chronic disorders, there are also many instances of relatively recent and often acute onset of hip pain that, given time, will

resolve spontaneously. This is often attributed to transient synovitis or to other ill-defined but self-limited processes.

CE Angle

CE angle is a radiographic measure of dysplasia. By the definition used here, only 1 patient had dysplasia (CE angle, $<20^\circ$) and 7 patients were grouped as borderline dysplasia (CE angle, 20° to 25°). By statistical analysis, there was no correlation between CE angle and outcome. There was also no trend noted toward poorer results with smaller angles (Fig 10). Dysplasia is often cited as a harbinger of poor results and perhaps even a contraindication to arthroscopy, but is not supported here. Nonetheless, it is prudent to take a practical approach to the overall clinical assessment, recognizing that there are many factors involved in the symptoms associated with the dysplastic hip.

Workers' Compensation and Pending Litigation

Interestingly, as a group, those cases involving Workers' Compensation and those involving pending litigation did better than those that did not involve either of these circumstances. Although this was not statistically significant, it certainly indicates that arthroscopy is not contraindicated in these groups and that a successful outcome can be achieved.

Subsequent Procedure

Undergoing an unplanned subsequent procedure constitutes a poor result, but in some cases it may not necessarily mean a clinical failure. Four patients with degenerative arthritis (2 osteoarthritis, 1 inflammatory arthritis, and 1 rheumatoid arthritis) subsequently underwent total hip replacement at an average of 12 months. However, in 3 of these cases, because the radiographs were essentially normal, the disease had gone unrecognized. The advanced disease, evident arthroscopically, provided important information in the subsequent decision to perform total hip arthroplasty. Also, 1 35-year-old patient with rheumatoid arthritis remained improved from his arthroscopic procedure (21 points) but subsequently chose to undergo a hip replacement 14 months postoperatively based on his observation of function in other patients with a hip replacement. In addition, 3 subsequent procedures (2 total hip arthroplasty, 1 core decompression) were performed on patients with AVN. These were discussed previously in this section.

One patient, discussed below, underwent second-look arthroscopy at the time of excision of an area of

myositis ossificans. The hip joint was clear, and his residual symptoms were independent of any intra-articular pathology (74 preoperative and 73 postoperative points at the time of subsequent procedure).

The final case represents a patient who sustained an acute twisting injury to her hip and underwent arthroscopy for a torn portion of the anterior labrum. After initial improvement, her symptoms deteriorated and a second arthroscopic procedure defined a partial rupture of the ligamentum teres, which was debrided. Again, a period of initial improvement was followed by deterioration in her symptoms, which ultimately responded to a third and final arthroscopy with more aggressive resection of the anterior labrum. The shortcomings of this case show how we are still learning to precisely define the nature of intra-articular pathology as well as the cause of intra-articular mechanical hip pain.

Complications

As noted, 2 complications occurred in 1 patient, each illustrating an important principle. A previous anatomic study has shown that branches of the lateral femoral cutaneous nerve will always pass close to the anterior portal.¹⁵ Laceration of the nerve can be avoided by careful attention to the details of the technique, but 1 of these branches will always be vulnerable to traction neuropraxia with vigorous instrumentation from this portal. In this example, once the portal tract had been developed, hand instruments were introduced along the path to remove multiple loose bodies resulting from synovial chondromatosis. It is easy to understand how 1 of the branches of the nerve lying close to this area could have been contused during the course of the procedure. The sensitivity of the lateral femoral cutaneous nerve to compression injury is also well acknowledged from meralgia parasthetica. In this case, as only small branches of the nerve are usually involved, the patchy area of reduced sensation is fairly small.

However, in this case, the patient also developed an area of myositis ossificans along the anterior portal tract with the lesion measuring approximately $2.25 \times 1 \times 1.50$ cm. The patient was quite thin and the mass had the mechanical effect of causing pain and irritation around the anterior aspect of the joint. In fact, it was hard to distinguish whether it was solely the lesion that was irritating the front of his hip, or whether he may have developed symptoms from residual intra-articular disease. The lesion was excised uneventfully 23 months after the index procedure, and

a second-look arthroscopy confirmed that the hip joint was still clear. Since then, the patient has continued to have resolution of his symptoms.

Myositis ossificans is a well-recognized complication associated with open hip surgery. It is rarely considered as a potential complication of arthroscopy. Thus, this case is an important reminder that, even though the likelihood of complications in arthroscopy is quite low, it is not negligible.¹⁶

CONCLUSIONS

Arthroscopic surgery of the hip is a well-established technique. This report substantiates the benefits of this procedure for a variety of disorders. Over time, continuation of the model proposed here will allow us to better define results and, consequently, the indications for this technique. It should be noted that, although arthroscopy may have a role in addressing coexistent pathology associated with AVN, as a palliative procedure for end-stage disease, it is uniformly unsuccessful.

The complications associated with this procedure, while not insignificant, are in the authors' opinion acceptable for the merits of the procedure in properly selected patients. This article represents the senior author's early experience in hip arthroscopy and, it is hoped, a point lower on the learning curve than our present understanding. Potential limitations associated with these early cases included reliability of investigative studies, ability to properly select patients, understanding and interpretation of intra-articular pathology as viewed arthroscopically, and the skills and technology for carrying out operative arthroscopy. Each of these limitations should be lessened over time. We have only begun to scratch the surface in fully defining the indications, contraindications, techniques, and complications associated with this procedure. This article and others like it should serve as an impetus and model for further investigative study.

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