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ORIGINAL STUDY

Results of The Learning Curve for Interventional Hip Arthroscopy : A Prospective Study

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This prospective study aims to explore hip arthroscopy, outcome and the effect of the learning curve. Using the non-arthritic hip score preoperatively and postoperatively in 120 patients with an average 23-month follow-up, a median improvement of 16 points was seen at 6 months ($p < 0.0001$, Wilcoxon's signed ranks) remaining at 2 years (15, $p < 0.05$). Dividing patients into consecutive chronological groups of 40, the learning curve was explored. At six-months scores improved by 12 ($p < 0.05$) in first 40, 15 ($p < 0.0001$) in second and 20 ($p < 0.0001$) in third. A reduction in THR (22.5%, 5%, 2.5%) and revision rates (10%, 7.5%, 0) was seen. An increase in cumulative percentage satisfaction (defined as minimum 10 points increase) was seen from 20th (45%) to 100th procedure (65%). Results significantly improve as experience increases, possibly due to improved surgical skill, preoperative workup or improved understanding of operative indications.

Key Words : Learning Curve ; Hip Arthroscopy ; Femoroacetabular Impingement.

INTRODUCTION

FAI and its association with labral and osteochondral pathology, is seen in a young population of active individuals. This group of patients previously fell into a difficult treatment area often waiting up to 21 months for diagnosis and referral to a specialist centre (*2*). The use of hip arthroscopy has offered management of pathologies that were previously under diagnosed, unrecognised or difficult to treat without open surgical dislocation of the joint (*8*). Hip arthroscopy is growing in popularity with more surgeons adopting the procedure. Reports show favourable results for treatment of young patients with various hip pathologies, however, many of these reports come from the pioneering surgeons who have undertaken thousands of procedures to date (*12*). Hip arthroscopy is technically demanding, with a steep learning curve. This prospective study describes the experience of a single surgeon series early in the use of this procedure and the setting up of his practice. The study describes the first 120 interventional arthroscopies performed and the associated learning curve. As such this work contributes a significant addition to this expanding field of minimally invasive surgery. Our hypothesis was that a learning curve exists within hip arthroscopy, improved outcomes would be expected as the curve is climbed.

MATERIALS AND METHODS

Over a 20-month period all patients undergoing interventional hip arthroscopy for femoro-acetabular impinge-

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ment were recorded on a prospective database (excel, Microsoft, USA). Patient demographics, clinical features, imaging performed, intra-operative findings and procedures undertaken were recorded. Patients were scored using the non-arthritic hip score (*4*) on the day of the procedure and at 6, 12 and 24 months post-operatively. Scores were compared at post-operative intervals to those seen preoperatively and statistical analysis was undertaken on Microsoft excel and StatsDirect statistical software V2.7.7 (http://www.statsdirect. com. England : StatsDirect Ltd.) using Wilcoxon's signed ranks test.

The first 120 consecutive patients in a single surgeon series starting an arthroscopy service as the sole provider within an institution were recorded. For exploration of the learning curve, patients were divided into 3 consecutive chronological groups of 40 patients and their outcome of non-arthritic hip score, need for revision arthroscopy and conversion to total hip replacement (THR) were recorded.

The senior author reviewed all patients pre-operatively with a standardised work-up, including full history and examination, plain radiography of the affected hip in two views and initially magnetic resonance arthrography (MRA) in all patients. The senior author changed his practice later in the cohort, performing Computer Tomography with 3-dimensional reconstruction (3D-CT) in all patients and MRA where deemed necessary. The operative procedure and post-operative rehabilitation were standardised. The patients were placed in the lateral position with use of a 3 portal technique. Traction was applied for entry to the joint and all interventions within the central compartment, with release and hip flexion when appropriate for any extra-articular intervention. Labral tears were repaired with suture anchors where indicated and chondral injuries were debrided and micro fracture undertaken when appropriate. Post-operatively, the patients underwent a standardised program of intensive physiotherapy and hydrotherapy.

As the aim of this study was to specifically look at FAI surgery, patients were excluded if they had an underlying diagnosis of hip dysplasia, previous Perthes disease, a history of inflammatory arthropathy with associated degenerative change evident on plain radiograph or a history of septic arthritis.

All patients involved in this study gave informed consent prior to inclusion and the study was authorised by the local research and development department. The study being an observational study, where the only change between the 3 arms was time period and surgical experience did not require formal ethical committee review but was performed in accordance with the Ethical standards of the 1964 Declaration of Helsinki as revised in 2000.

RESULTS

120 patients fulfilled the criteria for inclusion into this study, with a median age of 39 years (range 14 to 67) ; average follow-up was 23 months (12 to 43).

At arthroscopy 24 patients had a labral tear and a further 33 patients had evidence of labral degeneration, 70 patients had a chondral defect in the acetabulum (of which, 40 were Outerbridge grade (*3*) 1 or 2 and 30 were grade 3 or 4), 21 patients had chondral defects on the femoral head.

Twelve patients underwent THR at an average of 54 weeks post arthroscopy (range 22 – 132) and an average age of 48 years (39 – 66). All had grade 3 or 4 chondral damage at initial arthroscopy and demonstrated reduction in scores from 48 pre-operatively to 43 at 6 months. Seven patients required revision arthroscopy for continued symptoms and further resection of bony anatomy. Table I shows the non-arthritic hip scores for all patients within

Table I. — Results of Hip Arthroscopy : Median improvement in non-arthritic hip score for all patients at various post-operative periods.

Post-op, months	Pre-op score	Average post-op score	Average improvement (95% CI)	p-value	n
6	57	73	16 (12 to 20)	< 0.0001	102
12	57	68	11 (3 to 16)	0.003	63
24	57	72	15 (1 to 21)	0.03	25

Table II. — Learning Curve. Median improvement in non-arthritic hip score when compared to pre-operative score for 3 time periods.

	Pre-op score	Average post-op score	Average improvement (95% CI)	p value	n
Group 1	55	67	12 (4 to 22)	0.008	31
Group 2	57	72	15 (9 to 21)	< 0.0001	36
Group 3	58	78	20 (12 to 26)	< 0.0001	35

Table III. — "Learning Curve". Patient demographics, acetabular chondral damage, labral tears and degeneration of labrum at arthroscopy and progression to THR or revision arthroscopy for 3 time periods.

	Mean Age	Female	THR	Revision	Acetabular Chondral Damage	Labral Tear	Labral degen	
Group 1	43	(17-62)	67.5%	22.5%	10%	62.5%	30%	35%
Group 2	36 (14-66)	62.5%	5%	7.5%	65%	20%	27.5%	
Group 3	36 (16-67)	52.5%	2.5%	0	47.5%	10%	20%	

Table IV. — Intraoperative procedure for the 3 groups.

	Femoral reshaping	Labral debridemen	Labral repair	Rim recession	Labral detachment
Group 1	77.5%	47.5%	12.5%	5%	0
Group 2	82.5%	27.5%	2.5%	7.5%	0
Group 3	60%	10%	5%	17.5%	17.5%

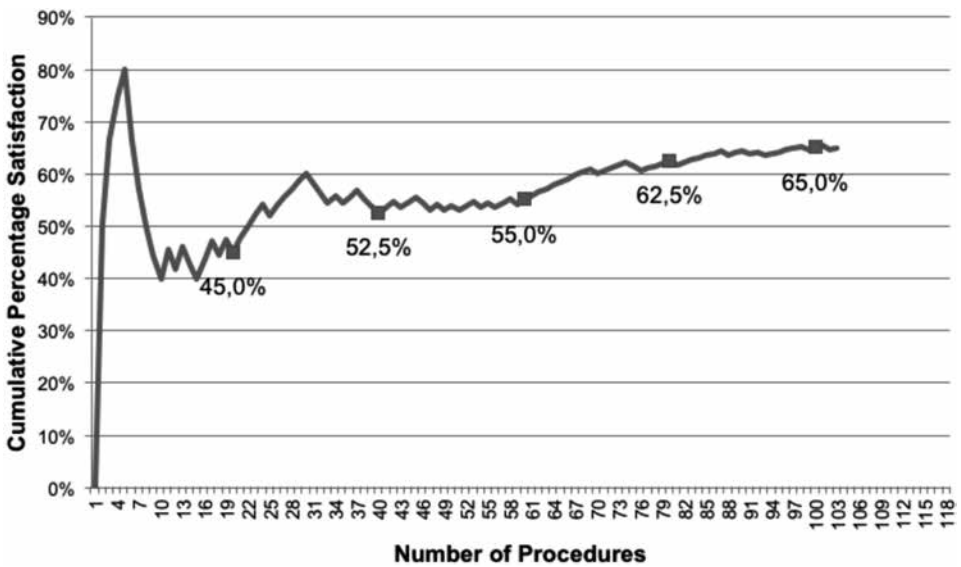

Fig. 1. — Cumulative Percentage of Satisfactory Outcomes : Measured as an improvement of 10 points or more on non-arthritic hip score at 6 months. Points and percentage satisfaction marked every 20 procedures.

the study, comparing the pre-operative score with the post-operative score at 6, 12 and 24 months. Table II and III show the ëlearning curveí for the three chronological groups of 40 with respect to scores and need for hip replacement or revision arthroscopy. Table IV shows the intraoperative procedure undertaken, where a rim recession was performed there was no evidence of a tear but a degenerate labrum was debrided where necessary. If a tear was coexistent with a pincer lesion, the labrum was taken down and a rim recession undertaken. Figure 1 shows the cumulative percentage satisfac-

tion for patients (*7*) with an acceptable outcome being an increase of 10 points on non-arthritic hip score compared to the pre-operative score.

There were 11 complications ; 6 chondral scuffs on joint entry, 4 transient parasthesias (2 foot and 2 lateral thigh) and 1 female patient with groin bruising from traction. No difference in complication rates was seen between the 3 groups.

DISCUSSION

FAI is thought to be a predisposing factor for osteoarthritis of the hip with early management of a symptomatic patient with this condition suggested to reduce the risk of degenerative disease (*6*). Hip arthroscopy for FAI is a relatively recent advancement in the orthopaedic management of young adult hip pathology, and for this reason, the uptake of the procedure among orthopaedic surgeons is increasing. This study represents the early practice of such a surgeon. As for many established consultants, the training of the senior author involved completion of a cadaveric course, departmental observational visits and initiation of observed practice within his institution. It did not involve a formal fellowship to a surgeon with an established practice. This study represents his early practice including these initial observed procedures.

The indications for hip arthroscopy are broad and sometimes controversial, including dysplasia, post traumatic arthritis, and inflammatory arthropathy (*12*). For the purpose of this study, patients with dysplasia, defined as a centre edge angle less than 25°, were excluded because of their tendency to hypertrophic labrum, altered mechanics and tendency to tears (*1*). We have concentrated on symptomatic FAI, labral pathology and osteochondral pathology, with maintainance of joint space greater than fifty percent on plain radiographs (Tönnis grade III (*16*)).

Overall, patients demonstrated a significant improvement in NAHS at 6, 12 and 24 months. This improvement is lower than previous studies (*11,15*) (29 and 25 points), however one study was retrospective and included a younger population of 33 years (*11*) and a second study looked at 22 patients with only 6 month follow-up (*15*), the final NAHS in this group with an average age of 42 years was similar to our study at 74 points, the larger improvement was due to a low pre-operative score. When we look at the outcome of our 3rd group of patients (after 80 previous arthroscopies were performed), we approach the success of these previous studies.

In examination of the learning curve three things are evident, firstly, as the surgeons experience increases the average postoperative scores increase from 67 in the first 40 to 78 in the final 40. Secondly, the cumulative percentage of satisfactory outcomes improves gradually from 45% by the 20th procedure to 65% satisfactory result by the 100th. The final objective marker of the learning curve is seen in revision rate and progression of disease to THR with a reduction of revision arthroscopy from 10% in the first 40 to 0 in the final 40, progression to THR reduced from 22.5% to 2.5% respectively. This may represent a time bias, with the first group having the longest follow-up. This is unlikely as the final patient within this series underwent hip arthroscopy over 52 weeks ago and at latest follow-up no patients within the groups had deteriorated significantly, with no patients listed for THR. The average time to listing for THR was 42 weeks post arthroscopy, with all patients noted to have a significant deterioration in symptoms by the 26th week post arthroscopy. If THR rate at 52 weeks is taken for comparison, in the 3 groups 15%, 2.5% and 0 are seen, respectively. The overall THR rate of 10% at 27 months (12 to 42 months) is comparable to previous studies of similar follow-up (*10,14*), but lower than studies with 5 year follow-up (11-30%) (*11,13*) suggesting that disease progression increases in the medium term resulting in an increasing number of arthroplasties.

Table 3 shows the patient demographics and pathology for the 3 groups. It can be seen that the average patient age reduces from 43 years to 36 years after the first 40 patients. The range of ages was similar, but the higher average age in the first group was due to a lower percentage of under-30 year olds (7.5%, 35% and 27.5% for the 3 groups respectively). The average preoperative and postoperative scores for the under-thirties was comparable to the overall group at 59 and 77

respectively, therefore in relation to NAHS, the data was not significantly altered between the groups. With regards to progression to THR however, it is difficult to make such an assumption as this procedure was undertaken in an older age group, an age group proportionally higher in the first 40 patients.

The intra-articular pathology was not comparable between the groups, with the rate of acetabular chondral damage reducing from 62.5% in the first 40 to 47.5% in the last and labral pathology reducing from 65% to 30% respectively. There are two reasons for this trend, firstly not only does hip arthroscopy have a learning curve, but the clinical and radiological assessment of the patient by the senior author involved a learning curve. With increased confidence in clinical signs of impingement, increased confidence in plain radiographic interpretation of FAI anatomy and less reliance on MR arthrograms, the surgeon found himself more likely to operate for signs of FAI regardless of any evidence of labral tears. Secondly, the surgeonís confidence in the technique had improved and his ability to deal with pincer lesions had developed. Thirty-five percent of patients in the final group underwent peri-labral recession or labral takedown and recession in the absence of a labral tear, compared to just 12.5% in the first 80 patients (undergoing a peri-labral recession alone, in the absence of takedown). In the first 80 procedures, the senior author was more likely to address the labral pathology alone, with less attention to acetabular bony anatomy. Results of labral repair are superior to those of debridement alone (*5*) and attention to bony anatomy is thought to reduce disease progression and resultant arthritis (*9*).

This study is a single surgeon series and as such has the limitations that it represents the learning curve of that individual, however the outcome scores are comparable to previous studies and we believe this learning curve is seen in the surgical practice of many starting this procedure. This is a large prospective series and we believe the findings are the first reported of its kind.

Patients show an improvement post hip arthroscopy even in the early stages of surgical practice, a gradual improvement in satisfaction is seen with a significant reduction in need for revision arthroscopy and conversion to THR as the learning curve is climbed. This is possibly due to improved surgical skill, preoperative workup and an improved understanding of operative indications. It can be recommended that surgeons planning on carrying out this surgery should undertake a formal fellowship with a high volume surgeon prior to independent practice.

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