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Research article

A history of spine surgery predicts a poor outcome after hip arthroscopy

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ABSTRACT

This study compared patient reported outcomes scores (PROMs) between patients undergoing hip arthroscopy who have and have not had previous lumbar spine surgery. We aimed to determine if prior spine surgery impacts the outcome of hip arthroscopy. Data were prospectively collected and retrospectively reviewed in patients who underwent hip arthroscopy between 2010 and 2017. Twenty cases were identified for analysis and matched to a control group. Four PROMs were collected pre-operatively and between 6 months and 2 years post-operatively (mean 16.2 months): Modified Harris Hip Score (mHHS), Hip Outcome Score-Activities of Daily Living (HOS-ADL), Hip Outcome Score-Sports (HOS-Sports) and the 33-item International Hip Outcome Tool (iHOT-33). Patients with previous spine surgery reported significantly worse (*P*-value <0.001) post-operative scores on all PROMs and smaller net changes on all PROMs with the difference on the mHHS (*P*-value 0.007), HOS-Sport (*P*-value 0.009) and iHOT-33 (*P*-value 0.007) being significant. Subsequent analyses revealed that the type of spine surgery matters. Patients with a spine fusion reported worse post-operative scores on all PROMs compared with patients with a spine decompression surgery with the difference on the mHHS (*P*-value 0.001), HOS-ADL (*P*-value 0.011) and HOS-Sport (*P*-value 0.035) being significant. Overall, patients with prior decompression surgery experienced considerable improvements from hip arthroscopy whereas patients with a prior spine fusion reported poor post-operative outcomes. Given these results, it is vital that hip preservation surgeons understand the impact of the lumbar spine on the outcome of hip arthroscopy.

INTRODUCTION

Arthroscopic hip surgery is an effective treatment for a variety of pathologies [1–4]. Hip arthroscopy has increased in prevalence 25-fold from 2006 to 2013 and its utilization across all age groups continues to grow [5–7]. As such, continuing to identify factors that can predict a poor surgical outcome is vital for the future of hip preservation surgery. Several prognosticators of a poor outcome after hip arthroscopy have already been identified, including advanced hip osteoarthritis (Tönnis Grade III) and a body mass index (BMI) over 25 [2, 8, 9]. However, we believe additional factors outside the hip joint can lead to inferior outcomes, particularly the lumbar spine. Therefore, we believe a comprehensive history and physical evaluation of patients' lumbar spine and spinopelvic biomechanics can be useful in predicting the outcome of hip arthroscopy.

Hip–spine syndrome was coined to describe the well-studied complex relationship between lumbar spine disorders and hip pain [10]. Studies have shown the negative impact of lower back pain on hip arthritis results [11, 12], and spine osteoarthritis has been correlated with an increased alpha angle as well as decreased anterior femoral neck offset [13]. However, there is a lack of research investigating hip–spine syndrome in regards to femoroacetabular impingement (FAI) and hip arthroscopy. Surgical modification to the lumbar spine alters hip biomechanics due to a loss of lumbar spine compensatory motion and the orientation of the spine also influences hip configuration: specifically pelvic tilt, sacral slope and acetabular orientation [14, 15]. Patients with prior lumbar spine surgery who undergo subsequent total hip arthroplasty (THA) consequently demonstrate increased rates of dislocation and revision as well as lower

scores on patient reported outcomes measures (PROMs) after THA [16–18]. Given the evidence that prior spine surgery affects hip biomechanical compensatory mechanisms and THA outcomes, we believe it is reasonable to infer similar effects on hip preservation surgery.

The purpose of our study is to compare PROMs between patients undergoing hip arthroscopy who have and have not previously had surgery to the lumbar spine. We hypothesize that for patients with a history of prior spine surgery (i) the net change from pre-operative to post-operative PROMs as well as the absolute outcome score on post-operative PROMs will be lower when compared with a matched control group, (ii) the net change from pre-operative to post-operative PROMs will be below previously published values for the minimal clinically important difference (MCID) [19] and the substantial clinical benefit (SCB) [20] after arthroscopic treatment for FAI and (iii) that these differences will be more pronounced in patients who have had a previous lumbar spine fusion when compared with patients who have had previous spine decompression surgery. To our knowledge, this is the first study that aims to determine if hip arthroscopy has reduced efficacy in this specific patient population. This will allow physicians to more accurately counsel patients about prognosis after surgery as well as establish realistic post-operative expectations.

MATERIALS AND METHODS

This study was approved by our institutions' institutional review board. Data were prospectively collected on patients who underwent hip arthroscopy between 2010 and 2017. We retrospectively reviewed medical records and radiographs for 1963 hip arthroscopy cases to identify patients who had previous spine surgery. The study excluded patients that (i) underwent concurrent bilateral hip arthroscopy, (ii) had a history of traumatic ipsilateral hip injury, (iii) had spine surgery due to a congenital deformity or (iv) had advanced hip osteoarthritis (defined as Tönnis Grade III).

Twenty-seven patients were identified who matched our inclusion criteria. Three patients were excluded due to their medical history: two patients had a history of traumatic hip injury and one had spine surgery due to a congenital deformity. Seven additional patients were excluded due to a lack of post-operative PROMs. After these exclusions, seventeen patients were included in this retrospective case–control study. Eleven of these patients had a prior spine fusion: eight at L5-S1 and three unilateral SI joint fusions. The six remaining patients had a discectomy (4) or laminectomy (2). Indications for spine surgery consisted of severe pain, failure of conservative treatment and findings on diagnostic imaging. Three of the fusion patients underwent staged bilateral hip arthroscopy with over 1 year between operations which provided a total of 20 cases for analysis (70% female, average age 39.3, range 25–50). The experimental cohort was divided into two sub cohorts based on the type of prior spine surgery: prior spine fusion ($n = 14$, 64% female, average age 40.4, range 25–50) and prior spine decompression surgery ($n = 6$, 83% female, average age 36.8, range 30–41).

Patients were matched to controls according to gender, age and the length of time after surgery when PROMs were completed. Matching criteria also included the presence or absence of a femoral osteochondroplasty during hip arthroscopy as this procedure can impact the recovery timeline. To improve the power of the study, controls were matched to patients on a 3:1 ratio.

All patients were assessed before and after hip arthroscopy with four hip specific PROMs: the Modified Harris Hip Score (mHHS), the Hip Outcome Score-Activities of Daily Living (HOS-ADL), the Hip Outcome Score-Sports (HOS-Sport) and the 33-item International Hip Outcome Tool (iHOT-33). Post-operative PROMs were collected between 6 months and 2 years after hip arthroscopy (mean 16.2 months).

We assessed the benefit of hip preservation surgery in this cohort by comparing the net change on PROMs pre-operatively to post-operatively as well as absolute post-operative outcome scores to a matched control group. Utilizing previously published values for the MCID [19] and the SCB [20] enabled further analyses. Additionally, dividing the cohort into two sub cohorts, spine fusions and spine decompression surgery, enabled assessment of the impact of the type of prior spine surgery.

Statistical analysis

Descriptive statistics for demographic and clinical characteristics are reported for all cohorts. Comparisons were made between the cohort of patients with prior spine surgery and controls matched for age, gender, procedure performed and the time length at which post-operative PROMs were completed. Comparisons were also made between two sub cohorts: sub cohort (1) patients with prior spine fusions and sub cohort (2) patients with prior spine decompression surgery. Frequency and percentage of patients who achieve the MCID and SCB for the mHHS, HOS-ADL, HOS-Sport and iHOT-33 are reported based on the net change from pre-operative to post-operative PROMs. A multivariable logistic model was fitted for each outcome score to evaluate whether prior spine surgery is associated with achieving the MCID or SCB after adjusting for other demographic and clinical characteristics. Previous research on patient reported outcomes after arthroscopic

treatment of FAI at our institution have defined an outcome score change for the MCID and the SCB. We used MCID values of 8.2, 8.3, 14.5 and 12.1 and SCB values of 19.8, 10.0, 29.9 and 24.5 on the mHHS, HOS-ADL, HOS-Sport and iHOT-33 respectively to define meaningful outcome improvement [19, 20]. Analyses were performed with SAS Software (version 9.3; SAS Institute).

RESULTS

For the experimental cohort composed of patients with prior spine surgery, the average pre-operative PROMs, post-operative PROMs, net change in PROMs and percentage of patients to achieve the MCID and the SCB are presented in Table I. Compared with the matched control group, the experimental cohort reported smaller net changes from pre-operative to post-operative PROMs on all four questionnaires with the difference on mHHS (*P*-values 0.007), HOS-Sport (*P*-values 0.009) and iHOT-33 (*P*-values 0.007) being significant. These comparisons, as well as comparisons to the MCID and the SCB, are presented in Fig. 1. Additionally, the average post-operative outcome score across all four PROMs for the experimental cohort were significantly worse (*P*-values <0.001) than the control group.

The average net change of the experimental cohort was nearly equivalent to the MCID on the mHHS and HOS-ADL, significantly higher (*P*-values <0.001) than the MCID on iHOT-33 and significantly smaller (*P*-values <0.001) than the MCID on HOS-Sports. These patients on average reported a smaller net change than the SCB on all four PROMS with the difference being significant (*P*-values <0.001) on the mHHS, HOS-Sport and iHOT-33.

Table I. Average pre-operative, post-operative and net change on the mHHS, HOS-ADL, HOS-Sport and iHOT-33 for patients with previous spine surgery who underwent hip arthroscopy as well as percentage of these patients to achieve the MCID and the SCB

	mHHS	*HOS-ADL*	*HOS-Sport*	*iHOT-33*
Pre-operative average (range)	47.6 (30.8–73.7)	58.2 (29.41–94.12)	28.2 (0–69.44)	23.3 (8.62–53.34)
Post-operative average (range)	56.9 (35.2–100)	66.4 (36.76–100)	34.4 (5.56–100)	40.9 (5.87–93.82)
Net change	9.3	8.2	6.1	17.6
Percentage of patients to achieve MCID	50% (10 patients)	35% (7 patients)	30% (6 patients)	60% (12 patients)
Percentage of patients to achieve SCB	12% (6 patients)	35% (7 patients)	15% (3 patients)	35% (7 patients)

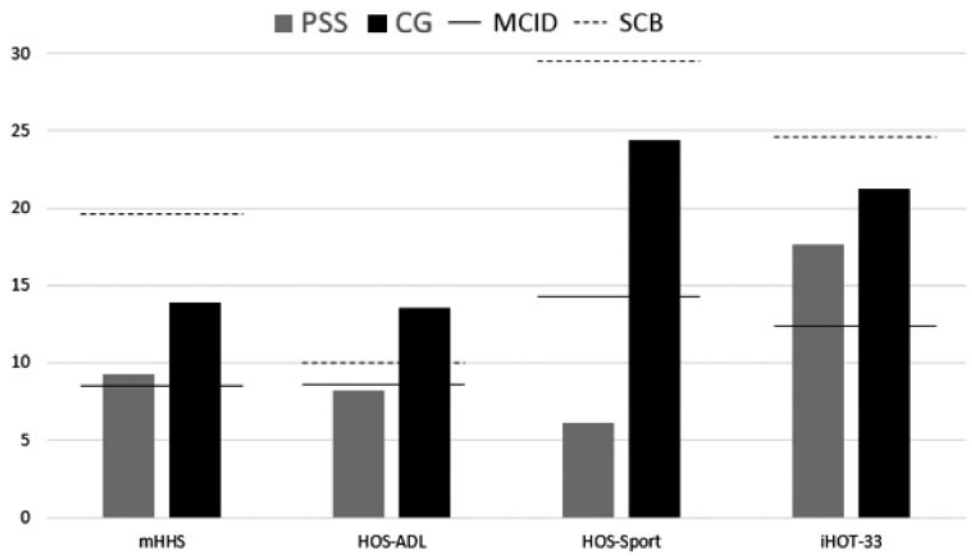

Fig. 1. Net change from pre-operative to post-operative outcome score on the mHHS, HOS-ADL, HOS-Sport and iHOT-33 for patients with prior spine surgery (PSS) versus matched control group (CG).

Table II. Average pre-operative, post-operative and net change on the mHHS, HOS-ADL, HOS-Sport and iHOT-33 for the spine fusion sub cohort and the spine decompression sub cohort as well as percentage of each sub cohort to achieve the MCID and the SCB

	mHHS	*HOS-ADL*	*HOS-Sport*	*iHOT-33*
Spine fusion sub cohort				
Pre-operative average (range)	44.2 (30.8–57.2)	52.5 (29.41–79.41)	22.6 (0–50)	19.4 (8.62–40.2)
Post-operative average (range)	48.2 (35.2–78.1)	59.4 (36.76–91.18)	24.2 (5.56–72.22)	33.7 (5.87–84.65)
Net change	4.1	6.9	1.6	14.3
Percentage of patients to achieve MCID	36% (5 patients)	36% (5 patients)	14% (2 patients)	50% (7 patients)
Percentage of patients to achieve SCB	14% (2 patients)	36% (5 patients)	7% (1 patient)	29% (4 patients)
Spine decompression sub cohort				
Pre-operative average (range)	55.7 (40.7–73.7)	71.3 (41.18–94.12)	41.3 (11.11–69.44)	32.3 (10.47–53.34)
Post-operative average (range)	72.6 (49.5–100)	82.0 (58.82–100)	58.5 (8.33–100)	57.6 (17.48–93.82)
Net change	16.9	10.7	17.3	25.3
Percentage of patients to achieve MCID	67% (4 patients)	33% (2 patients)	67% (4 patients)	83% (5 patients)
Percentage of patients to achieve SCB	50% (3 patients)	33% (2 patients)	33% (2 patients)	50% (3 patients)

The average pre-operative PROMs, post-operative PROMs, net change in PROMs and percentage of patients to achieve the MCID and the SCB for the two sub cohorts are presented in Table II (patients with a prior spine fusion) and (patients with prior spine decompression surgery). The decompression surgery sub cohort reported higher average values of net change on all four PROMs compared with the fusion sub cohort as well as higher post-operative outcome scores on all four PROMS with the difference on the mHHS (*P*-values 0.001), HOS-ADL (*P*-values 0.011) and HOS-Sport (*P*-values 0.035) being significant.

The fusion sub cohort on average reported a significantly (*P*-values <0.001) smaller net change than the MCID on the mHHS, HOS-ADL and HOS-Sport. Their average net change on iHOT-33 was higher than the MCID, however, this was not significant (*P*-values 0.1443). This sub cohort on average reported significantly smaller (*P*-values <0.001) net changes than the SCB on all four PROMs.

The decompression surgery sub cohort on average reported a net change greater than the MCID on all four PROMs with the difference on the mHHS, HOS-ADL and iHOT-33 being significant (*P*-values <0.001). This cohort reported a slightly greater net change on HOS-ADL and iHOT-33 compared with the SCB and reported smaller net changes than the SCB on mHHS and HOS-Sport, with the difference on HOS-Sport being significant (*P*-values <0.001). Comparisons between the sub cohorts, as well as comparisons to the MCID and SCB, are presented in Fig. 2.

DISCUSSION

The results of our study suggest that hip arthroscopy may have limited efficacy as a treatment for FAI when a patient has had prior spine surgery, particularly a prior spine fusion. Using the net change from pre-operative to post-operative PROMs as a metric to assess the benefit of hip arthroscopy revealed that the experimental cohort reported significantly less improvement from hip arthroscopy as well significantly worse post-operative outcome scores compared with the control group. Additional metrics used to assess the benefit of hip arthroscopy in this study included the MCID, which is defined as the smallest change that a patient considers meaningful [19], and the SCB, which is defined as improvements that the patient perceives as clinically considerable [20]. While 60% of patients in the experimental cohort achieved the MCID on iHOT-33, fewer than 50% achieved the MCID on the mHHS, HOS-ADL and HOS-Sport and a majority of the cohort failed to achieve the SCB on all four PROMs. These results substantiate our belief that prior spine surgery can decrease the efficacy of hip arthroscopy. Separating our cohort on the basis of the type of prior spine surgery revealed that patients with a previous spine

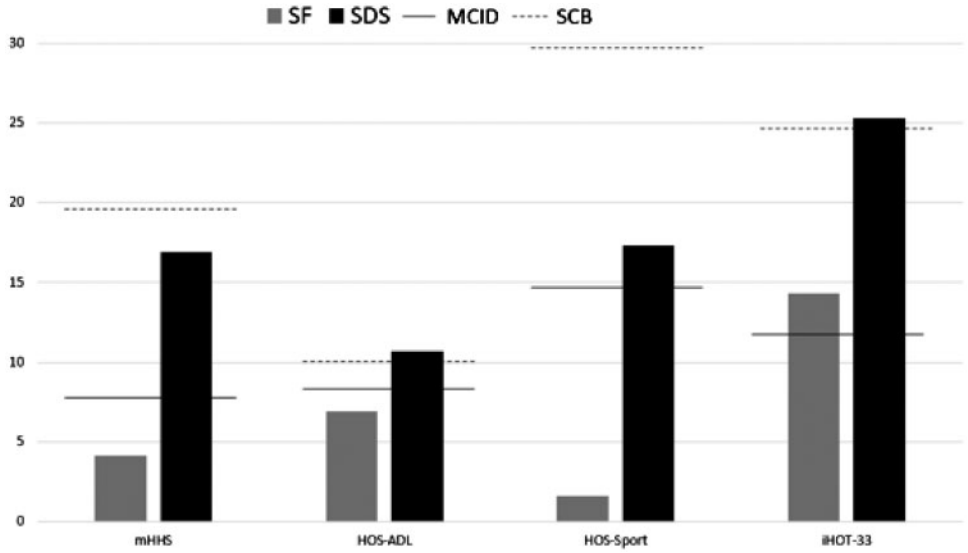

Fig. 2. Average net change from pre-operative to post-operative outcome score on the mHHS, HOS-ADL, HOS-Sport and iHOT-33 for patients with a prior fusion (PF) versus patients with spine decompression surgery (SDS).

fusion, compared with those with previous spine decompression surgery, had consistently worse post-operative outcome scores and smaller net changes from pre-operative to post-operative PROMs. While the patients with a spine prior fusion reported modest results after hip arthroscopy, patients with prior decompression surgery reported considerable improvements after hip arthroscopy, comparable to the benefit reported by the control group.

Multiple studies have assessed the anatomic relationship between the hip and spine [15, 21–23] and the biomechanical impact of lumbar spine surgery on the results of THA has been identified [14–16, 21]. To our knowledge, this is the first study that has expanded the discussion of the relationship between the hip and lumbar spine to hip arthroscopy. Our results suggest that patients with prior spine surgery, specifically prior spine fusion, have inferior outcomes after hip arthroscopy when compared with matched FAI controls. Research in arthroplasty has shown that the results of THA are directly impacted by the loss of spinal and pelvic motion that is associated with spinal fusion [15]. Based off this information, we speculate that the outcomes in our study were due to impairment of the compensatory mechanisms of the lumbar spine after fusion. However, since an in depth examination of hip/spine biomechanics was not included in this study, we cannot conclude this with certainty. The hip joint consists of two mobile osseous components, the proximal femur and the acetabulum/pelvis, which move in concert during various tasks like sitting, climbing stairs or putting on shoes to avoid FAI. Sagittal pelvic alignment, which is influenced by the lumbar spine, represents the motion of the acetabulum/pelvis and has been shown to change between sitting and standing in patients with and without FAI. However, it has been shown that patients with symptomatic FAI have less change in pelvic sagittal alignment between standing and sitting than those without FAI. Those with symptomatic FAI also sit with more anterior pelvic tilt which causes patients to increase their hip flexion leading to impingement [24]. Thus, lumbar motion is critical to this compensatory mechanism, however, loss of motion at fused spinal segments is one of the outcomes of spinal fusion [25, 26], which thereby decreases the lumbar spine's ability to contribute to the compensatory changes in pelvic sagittal alignment [21]. We argue this loss of compensation predisposes patients who have had a spinal fusion and undergo subsequent hip arthroscopy for residual impingement after hip arthroscopy.

Our study focused on pain and functional outcomes after hip arthroscopy via four different patient reported outcome measures. The results showed that patients with prior spine surgery will improve after hip arthroscopy. However, the improvement reported is unlikely to be above the published values for the MCID and the SCB and worse than patients who undergo hip arthroscopy and have not had prior spine surgery. This information can serve as a prognosticator of a less successful outcome and be useful to both surgeon and patient in a clinical setting when determining the possible benefit of hip arthroscopy. Analysis of the sub cohorts strongly suggests that the type of spine surgery matters. The decompression sub cohort

on all four PROMs had a change in outcome score that was above the MCID and on two of the four PROMs (HOS-ADL and iHOT-33) above the SCB. In contrast, the fusion sub cohort, with the exception of the MCID on iHOT-33, was well below the MCID and SCB across all PROMs. These results suggest that patients with a prior spine fusion may be less than ideal candidates for hip preservation surgery while patients who have had a prior spine decompression surgery, such as a laminectomy or discectomy, can considerably benefit from arthroscopic management of FAI. Due to this difference, hip preservation surgery should be approached with caution when a patient with a prior spine fusion presents with symptomatic FAI. Lengthy discussions regarding expectations, careful patient selection, pre-operative surgical counseling and a comprehensive evaluation of the lumbar spine and spinopelvic biomechanics is recommended.

There are several limitations to this study. Foremost the sample size of our cohort is small which limits our statistical power. A complete knowledge of our cohort's spinal history is also lacking. Data concerning the outcomes of spine surgery were not available for all of our patients and not included in this study. This would have been useful in assessing the benefit of subsequent hip arthroscopy. While we were able to analyse important subjective data such as PROMs, objective data such as hip ROM, lumbar spine ROM, radiographic results and the need for subsequent surgeries were not available for all patients and therefore not included in this study. We utilized four patient administered questionnaires to assess pain and functional capacity before surgery and between 6 months and 2 years after hip arthroscopy. This study could be improved with a longer follow up time and multiple time points of data collection. Finally, patients were matched to controls on the basis of age, gender, procedure performed during arthroscopy and the time length at which post-operative PROMs were completed. However, BMI data were not available for each patient. This presents a potential confounding variable as an increased BMI correlates with a poor surgical outcome after hip arthroscopy [9]. Despite these limitations, this study provides a first look at the short term impact of arthroscopic hip surgery on patients with prior spine surgery. Further research is needed in the form of larger analyses and more comprehensive investigations to determine how lumbar spine surgery alters spinopelvic biomechanics and thereby affects the potential success of hip preservation surgery.

CONCLUSION

Our data support our principal hypothesis that hip arthroscopy has less efficacy in patients with prior spine surgery, particularly for patients with a prior spine fusion. However, our results also suggest that patients with a prior spine decompression surgery, such as a laminectomy or discectomy, can substantially benefit from hip arthroscopy. The modest improvement for the sub cohort composed of patients with a prior spine fusion, as well as the outcome scores on post-operative PROMs, indicate that these patients may be predisposed for a less successful surgical outcome. Based off our results, hip preservation surgery should be approached with caution when a patient with a prior spine fusion presents with symptomatic FAI. Careful patient selection and surgical counseling is recommended to manage expectations and accurately prognosticate outcomes. Future research aimed at determining how lumbar spine surgery alters spinopelvic biomechanics and thereby affects the potential success of hip preservation surgery would be useful to both clinician and patient when deciding upon treatment.

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CONFLICT OF INTEREST STATEMENT

None declared.

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