

## Defining the Learning Curve for Hip Arthroscopy: A Threshold Analysis of the Volume-Outcomes Relationship

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### Summary:

Stratum specific likelihood ratio analysis of 8,041 hip arthroscopies defined 4 strata of surgeon career volume associated with significantly different risks of subsequent surgery after primary hip arthroscopy. Cases performed by surgeons with career volumes over 519 had significantly lower risk of subsequent hip surgery than those performed by lower-volume surgeons.

### Abstract:

**Introduction/Objective:** Hip arthroscopy has emerged as an effective procedure for the treatment of femoroacetabular impingement and related hip disorders. However, the procedure is technically challenging and is widely believed to have a steep learning curve, which is not well defined. We aimed to define the learning curve through which surgeons become proficient at hip arthroscopy, demonstrated by decreased subsequent hip surgeries after the primary procedure.

**Methods:** Using the New York State SPARCS database, we identified hip arthroscopy procedures performed by individual surgeons between 2003-2012 and followed these cases for subsequent hip surgery (revision hip arthroscopy, total hip arthroplasty, or hip resurfacing) within five years of the original procedure. For each case, career volume was calculated as the number of previously-performed hip arthroscopies by the operating surgeon. Stratum specific likelihood ratio (SSLR) analysis of a receiver operating characteristic curve established discrete volume strata with significantly different risks of subsequent surgery within five years. The effect of surgeon career volume on risk of subsequent hip surgery was assessed using a Cox proportional hazards model adjusting for patient age, sex, race/ethnicity, insurance type, and concurrent diagnosis of hip osteoarthritis.

**Results:** 8,041 hip arthroscopies were performed by 251 surgeons in New York State between 2003-2012, 989 (12.3%) of which underwent subsequent hip surgery within five years. SSLR analysis identified 4 strata of surgeon career volume associated with distinctly different frequencies of subsequent surgery after hip arthroscopy: The lowest volume stratum (0-97) had the highest frequency of subsequent surgery (15.4%), and frequencies declined in the medium (98-388), high (389-518) and highest (>519) strata (13.8%, 10.1% and 2.6% respectively). There was an increased risk of subsequent surgery in each stratum compared to the highest volume stratum (low volume HR[95% CI]:3.21[2.28,4.52], medium:3.36[2.38,4.76], high volume:2.77[1.38,4.18];  $p<0.0001$  for all). Patients with concurrent diagnosis of hip osteoarthritis (2.10[1.80,2.44],  $p<0.0001$ ) and those with Medicaid or Medicare (1.53[1.08,2.15], 1.29[1.00,1.66],  $p<0.0001$ ) had increased risk of subsequent surgery. Patients 30 years or older also had increased risk compared to those 29 or younger (30-39: 1.54[1.23-1.93], 40-49: 2.40[1.96-2.94], 50+: 3.29[2.68,4.05];  $p<0.0001$  for all). Risk of subsequent surgery was lower in patients of Black (0.66[0.46, 0.95],  $p=0.024$ ) and other race (0.76 [0.62, 0.92],  $p=0.005$ ) compared to White patients, but it was not affected by sex.

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Conclusion: The learning curve for hip arthroscopy was unexpectedly steep. Frequency of subsequent surgery declined to 10% or less only after surgeons had performed at least 388 procedures, and cases performed by surgeons with career volumes over 519 had significantly lower risk of subsequent hip surgery than those performed by lower-volume surgeons.