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Predicting Avascular Necrosis after Unstable Slipped Capital Femoral Epiphysis

Jonathan Warren
Children's Mercy Kansas City

Alexander Metoxen
University of Missouri - Kansas City

Michael Held
University of Missouri - Kansas City

Brant Ansley
University of Missouri - Kansas City

Berglund Lisa
Children's Mercy Kansas City

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Submitting/Presenting Author (must be a trainee): Jonathan R. Warren, M.D. (orthopaedic surgery research fellow)
Primary Email Address: jrwarren@cmh.edu

☐ **Medical Student**
☐ **Resident/Psychology Intern (≤ 1 month of dedicated research time)**
☐ **Resident/Ph.D/post graduate (> 1 month of dedicated research time)**
☐ **Fellow**

Primary Mentor (one name only): Lisa Berglund, M.D.**Other authors/contributors involved in project:** Jonathan R. Warren, M.D.,[1] Alexander Metoxen, M.D.,[2] Michael Held,[2] M.D., Brant Ansley, M.D.,[2] Lisa Berglund, M.D.[1]

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Describe role of Submitting/Presenting Trainee in this project (limit 150 words): Primary author developed methodology of analysis, analyzed data, and wrote abstract

Background, Objectives/Goal, Methods/Design, Results, Conclusions limited to 500 words

Background: There is no consensus in the literature on the risk of developing avascular necrosis (AVN) after unstable slipped capital femoral epiphysis (SCFE). In recent years, a number of studies have sought to better characterize risk factors for AVN in this population. However, to the best of our knowledge, there is no study that uses predictive modeling to assess the chance of developing AVN based on different patient-centric factors.

Objectives/Goal: Our goal is to assess whether or not previously-published risk factors for AVN in unstable SCFE such as duration of symptoms, reduction type, type of surgery, timing of surgery, and severity of slip angle, are predictive of whether or not a patient will develop AVN.

Methods/Design: This was a 10-year chart review of patients with unstable SCFE. All patients had at least 12 months final follow-up. Receiver operator characteristic (ROC) area under the curve (AUC) analysis was performed to assess the predictive probability of developing AVN for all variables collected. An 8-stage hierarchical multivariable logistic regression was performed to control and adjust for variability between patients. Having no reduction in the operating room was identified as a confounder, and ROC AUC analysis was repeated after controlling for this variable.

Results: Our total cohort included 81 patients (61.7% male) with average age of 12.7±1.7 years, average BMI of 28.5±6.4, and average BMI percentile of 89.8±19.6. ROC analysis demonstrated an AUC of 0.73 (CI 0.62-0.85, p=0.006) for preoperative slip angle and 0.78 (CI 0.65-0.90, p=0.001) for postoperative slip angle reduction in predicting postoperative development of AVN. Logistic curves were created based on AUC analysis to determine the risk of AVN based on preoperative slip angle and slip angle correction (Figure 1). Eighteen (22.2%) patients developed AVN and seventeen (20.9%) eventually developed contralateral SCFE. Between the patients who developed AVN and those who didn't, AVN patients were significantly older (13.1±1.6 vs. 12.5±1.7, p=0.033), had a significantly greater preoperative slip angle (54.6±18.3 degrees vs. 44.4±17.1 degrees, p=0.006), and were more likely to have had slip progression after initial fixation (p=0.004). The Odds Ratio (OR) of developing AVN after slip progression was 8 (CI 2.4-26.9) and Relative Risk (RR) was 4.1 (CI 1.9-8.6).

Conclusions: This study contains one of the largest cohorts of patients with unstable slips analyzed to date. Using ROC AUC analysis, preoperative slip angle and postoperative slip angle correction are acceptable predictors of developing AVN. Using these logistic curves, surgeons and clinicians can estimate the percent chance that AVN will occur based on preoperative slip angle and slip angle reduction. AVN may be more likely to develop in older children who have higher slip angles. Additionally, slip progression is a significant risk factor for development of AVN.

Figure 1: Logistic Plots for Preoperative Slip Angle and Slip Angle Correction