2009 OREF Resident Research Symposia
Midwest Region

A Novel Biomechanical Method to Assess the Risk for Slipped Capital Femoral Epiphysis in Children

Robert Ellis; **Alfred Atanda**; Jimmi Mangla; John M Martell
University of Chicago

Introduction: There is no consensus on the surgical indication for prophylactic pinning of the contra-lateral hip in patients presenting with slipped capital femoral epiphysis (SCFE). Young skeletal age, the posterior slip angle and high femoral offset have been advocated as indicators for contra-lateral prophylactic pinning in patients with SCFE. We have developed custom software that calculates the shear stress in the capital femoral epiphysis using a computer assisted method based on an AP pelvis radiograph and the patient's body weight. We hypothesize that the risk of slipped capital femoral epiphysis will be greater in those patients having high shear stress in the epiphyseal cartilage. In this study we attempt to develop a predictive model for the risk of slipped epiphysis in the contra-lateral hip of patients undergoing unilateral SCFE pinning using epiphyseal shear stress, clinical and anatomic factors. The development of a predictive model for the risk of SCFE would be a valuable addition to the surgical indication for prophylactic pinning of the epiphysis.

Materials and Methods: After IRB approval we retrospectively selected 40 patients with SCFE admitted in the past to the University of Chicago medical Center for surgical pinning. Nine of these patients were known to have developed contra-lateral SCFE requiring surgical pinning as well. 31 of these patients have not required contra-lateral pinning to date. We analyze the AP pelvis and frog leg images of all patients with SCFE using a computer assisted custom software that determined the shear stress in the capital femoral epiphysis. The software first calculates the joint reaction force factor based on the patient's anatomy and body weight. The software uses a lever arm analysis followed by free body diagram solution for the joint reaction force of the hip. The capital femoral epiphysis is then traced by the user and broken into 10 equal line segments. For each segment the perpendicular and parallel components of the joint reaction force vector are calculated and the parallel components totaled to determine the overall shear stress in the epiphysis. A binary logistic regression model was developed using the predictive variables of femoral offset, joint reaction stress, shear stress of the epiphysis, body weight, age, abductor lever arm and body weight lever arm. Correlation analysis revealed significant correlations between femoral offset, body weight lever arm, abductor lever arm and joint reaction stress. A binary logistic regression model was developed using the prediction variables of joint reaction stress and AP epiphyseal shear and the outcome variable of epiphyseal pinning for SCFE. A leave one out binary logistic regression was then performed such that each case was judged by a model that it did not contribute to, and each case contributed to a model that judged all other cases. The accuracy, sensitivity, and specificity of this analysis were calculated. ROC analysis was performed to determine the az value for the predictive model. 95% confidence limits were used to determine whether the binary logistic regression model was significantly related to the development of SCFE.

Results: The binary logistic regression was significantly related to the development of SCFE ($P. < 0.05$). The model was 82.5% accurate with 55.5% Sensitivity and 90.3% Specificity. ROC analysis showed an az value of 0.695.

.

Conclusions: We have developed a binary logistic regression model that successfully predicts SCFE in the hip of patients who are at risk of developing a slip. This tool will improve the basis for surgical decision making regarding the need for prophylactic pinning of hips in children at risk for slipped capital femoral epiphysis.

Statement of competing interests: None