In Vivo Determination of THA Kinematics for Subjects Having Two Different Surgical Approaches.

INTRODUCTION: Previous fluoroscopic analyses of Total Hip Arthroplasty (THA) determined that the femoral head slides within the acetabular cup, leading to separation of certain aspects of the articular geometries. Although separation has been well documented, it has not been correlated to clinical complications or a more in-depth understanding of the cause and effect. Surgical technique is one of the important clinical factors when considering THA procedures, and it is hypothesized that it could affect the magnitude and occurrence of femoral head separation (sliding) in THAs. Hence, the objective of this study was to determine and compare in-vivo THA kinematics for subjects implanted with a THA using two different surgical approaches.

METHODS: Thirty seven subjects, each implanted with one of two types of THA were analyzed under in vivo, weight-bearing conditions using video fluoroscopy while performing a sit-to-stand activity. Twenty (20) subjects were implanted by Surgeon 1, 10 using a traditional (long incision) posterolateral approach and 10 using a MIS (short incision) posterolateral approach. Surgeon 2 implanted 10 subjects using the posterolateral approach, while the remaining 7 were implanted by Surgeon 3 using an anterolateral approach. All patients with excellent clinical results were invited to participate in the study (HHS > 90). 3D kinematics of the hip joint was determined, with the help of a previously published 2D-to-3D registration technique [1] (Figure 1). From a completely seated position to the standing position, four frames of the fluoroscopy video were analyzed.

RESULTS: Of the 37 THAs analyzed in this study, 21 THAs exhibited greater than 1.0mm of femoral head separation in at least one of the four analyzed increments. Maximum incidence of separation was seen in the completely seated increment with 11/21 THAs experiencing maximum separation at this increment. Six out of the twenty-one (6/21) THAs exhibited their maximum separation at the completely standing increment, while 3/21 and 1/21 cases of maximum separation were seen at the 33% and 66% of the activity respectively. Also, 8/21 THAs exhibited separation in multiple increments of the sit-to-stand activity, while the remaining 13/21 subjects exhibited separation in only one increment.

Eighteen of the thirty subjects (18/30) implanted using the posterolateral approach and 3/7 subjects implanted using the anterolateral approach exhibited femoral head separation in at least one increment. Also, 6/18 cases for the posterolateral approach, and 1/3 cases for the anterolateral approach exhibited femoral head separation in multiple increments. Average maximum separation was 1.3mm and 1.0mm for the posterolateral and anterolateral approaches respectively. The maximum separation seen at any increment for the two approaches was, 2.4mm for the posterolateral approach and 1.7mm for the anterolateral approach. Eleven of the twenty (11/20) patients implanted by Surgeon 1, 7/10 implanted by Surgeon 2 and 3/7 implanted by Surgeon 3 exhibited femoral head separation at least one increment. Also, 2/11 cases for Surgeon 1, 4/7 cases for Surgeon 2 and 1/3 cases for Surgeon 3 exhibited femoral head separation greater than 1.0mm in multiple increments. Average maximum separation was 1.2mm, 1.4mm and 1.0mm for Surgeons 1, 2 and 3 respectively (Figure 3). The maximum separation seen at any increment for the three surgeons was, 1.8mm for Surgeon 1, 2.4mm for Surgeon 2 and 1.7mm for Surgeon 3. Of the 20 subjects implanted by Surgeon 1, 3/10 subjects implanted using the traditional long incision and 8/10 subjects implanted using the MIS technique exhibited femoral head separation greater than 1.0mm.

DISCUSSION: Subjects in all groups experienced some degree of femoral head separation at all increments of the sit-to-stand activity that was analyzed. The magnitude and frequency of separation greater than 1.0mm varied between each surgeon group, between incision types, between incision lengths and between the two types of THA that were analyzed. This study suggests that there may be a correlation between incision lengths and surgical approach with femoral head separation in THAs.

REFERENCES: