THE EFFECT OF FEMORAL ANTEVERSION ON POSTERIOR DISLOCATION OF THE ARTIFICIAL HIP JOINT

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Introduction:
Dislocation after total hip arthroplasty (THA) continues to be a major complication affecting the overall success of prosthetic hip replacement, with a reported incidence of 1-10%. This is a multifactorial problem, influenced by patient selection, surgical approach, implant design and the orientation of the prosthetic components. In previous clinical reviews, an unusually low incidence of dislocation has been reported with femoral stems with an antverted femoral neck. While this may be attributed to the increased anterior offset of the femoral head, it is not possible to isolate the contribution of femoral anteversion to joint stability. In this study, the effect of femoral anteversion on posterior dislocation in THA has been addressed using a cadaveric model of the artificial hip joint.

Methods:
Five fresh cadaveric specimens were retrieved at post-mortem dissection from five donors (3 female, 2 male) ranging in age from 42-85 years (average: 64). A total hip replacement was performed on each specimen using standard surgical techniques. An uncemented femoral component (Meridian, Howmedica Inc.) with a 28 mm head was inserted into the right femur of each specimen. A porous coated acetabular component (Vitalock, Howmedica Inc.) with a neutral liner was inserted at 40 abduction and oriented in the same plane of anteversion as the original bony acetabulum. Before testing, each specimen was mounted in a bi-axial servohydraulic testing machine (Bionix, MTS) via a mounting block attached to the body of L5. The femur was fixed to a sliding platform via a fixture that allowed the internal rotation of the joint to be fixed without restricting the axial motion of the femur with respect to the pelvis. The angles of flexion, adduction and internal rotation of the hip joint were continuously monitored with rotational transducers attached to the distal portion of the femur. The flexion angle was set by lowering the pelvis until the desired position was achieved. The specimen was loaded via a system of cables was used to simulate the seven major muscle groups stabilizing the hip joint during rising from a low chair. The force applied by each cable was derived from quantitative electromyographic (EMG) data and anatomic measurements.

Hip flexion was varied from 90-120 degrees in 5 degree increments with the femur in neutral rotation. At each angle of flexion, the adduction of the hip joint was increased from neutral at 3 per second until dislocation was observed. The angle of rotation, flexion, and adduction angles were continuously sampled at 25 Hz using a computerized data acquisition system (Data Translation, Inc.). The three dimensional position of the hip at impingement and dislocation were recorded electronically. The experiment was repeated with the femur in ten degrees of retroversion and 10 degrees of anteversion.

Results:
The range of motion of the hip joint increased dramatically with anteversion of the femur. This effect was more pronounced as the hip flexion angle increased from 90-120°, with significant increases in range of motion to dislocation at flexion angles greater than 110°. At 110° of flexion, there was a four-fold increase in the adduction of the hip range of motion to impingement in moving from ten degrees femoral anteversion to ten degrees of retroversion (5.2 ± 3.4 - 21.4 ± 1.0, p < 0.05). The amount of adduction necessary to dislocate the hip increased by 9 degrees (18.4 ± 3.6 - 27.1 ± 3.9, p < 0.05). In addition, the absolute range of motion of flexion increased by 12° (101-113) when comparing a ten degree retroverted position to a ten degree antverted femoral position.

Discussion:
This study uses a dynamic model of the artificial hip joint to simulate posterior dislocation in THA. The results indicate that femoral anteversion plays an important role in maintaining range of motion and stability of the artificial hip joint. Throughout the different conditions tested, an retroverted femoral position led to a significant reduction in the range of motion of the prosthetic hip than a neutral or anteverted position. This study illustrates that proper positioning of the femoral component to avoid retroversion is a critical factor in preventing posterior dislocation of the artificial hip joint.