



## ORIGINAL ARTICLE

# Instability of total hip replacement: A clinical study and determination of its risk factors<sup>☆</sup>



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### KEYWORDS

Instability;  
Dislocation;  
Total hip  
arthroplasty;  
Finite elements;  
Anteversion

### Abstract

**Objectives:** To determine the risk factors associated with prosthetic dislocation and simulate a finite element model to determine the safe range of movement of various inclination and anteversion cup positions.

**Material and methods:** Retrospective case control study with 46 dislocated patients from 1994 to 2011. Control group: 83 randomly selected patients. Dislocation risk factors described in the literature were collected. A prosthetic model was simulated using finite elements with 28, 32, 36 mm heads, and a 52 mm cup. Acetabular position was 25°, 40°, and 60° tilt and with 0°, 15° and 25° anteversion. In extension of 0° and flexion of 90°, internal and external rotation was applied to analyze the range of movement, maximum resisting moment, and stress distribution in the acetabulum to impingement and dislocation.

**Results:** There was greater dislocation in older patients ( $p=0.002$ ). Higher dislocation in fractures than in osteoarthritis ( $p=0.001$ ). Less anteversion in dislocated patients ( $p=0.043$ ). Longer femoral neck in dislocated patients ( $p=0.002$ ). Finite element model: lower dislocation when there is more anteversion, tilt and bigger femoral heads.

**Discussion-conclusions:** Advanced age and fractures are the major risk factors for dislocation. "Safe zone" of movement for dislocation avoidance is 40–60° tilt and 15–25° anteversion. Both the defect and excess of soft tissue tension predispose to dislocation. Bigger femoral heads are more stable.

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**PALABRAS CLAVE**

Inestabilidad;  
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cadera;  
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Anteversión

**Inestabilidad de la artroplastia total de cadera: estudio clínico y computacional de sus factores de riesgo****Resumen**

**Objetivos:** Determinar los factores de riesgo asociados a la luxación protésica y simular un modelo mediante elementos finitos que determine los arcos de movimiento seguros en cada angulación y anteversión del cotilo.

**Material y métodos:** Casos-control retrospectivo con 46 pacientes luxados desde 1994 hasta 2011. Grupo control: 83 pacientes elegidos de forma aleatoria. Se recogieron los factores de riesgo de luxación descritos en la literatura. Se simuló un modelo protésico mediante elementos finitos con cabezas de 28, 32, 36 mm y cotilo de 52 mm. Posición acetabular de 25°, 40° y 60° de inclinación y 0°, 15° y 25° de anteversión. Para cada combinación se estudió la flexión de 90° y la extensión de 0° aplicando rotación interna y externa midiendo el rango de movimiento y el momento resistente hasta el choque-luxación y la distribución de tensiones en la superficie del cotilo.

**Resultados:** Mayor edad en luxados ( $p=0,002$ ). Mayor luxación en fracturas respecto artrosis ( $p<0,001$ ). Menor anteversión en luxados ( $p=0,043$ ). Mayor longitud de cuello femoral en luxados ( $p=0,002$ ). Simulación de finitos: menor luxación cuanto mayor inclinación, anteversión y diámetro de cabeza femoral.

**Discusión-conclusiones:** La edad avanzada y la fractura son los principales factores favorecedores de la luxación. El área de seguridad libre de luxación comprende 40°-60° de inclinación y 15°-25° de anteversión. Tanto el defecto como el exceso de tensión de las partes blandas predisponen a la luxación. Las cabezas de mayor tamaño son más estables.

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**Introduction**

Total hip arthroplasty (THA) is a very frequent procedure in Traumatology and Orthopedic Surgery Services, and although its effectiveness is very high, it is not without complications such as aseptic loosening, dislocations, infections and periprosthetic fractures.

Despite the advances in prosthetic techniques and models, dislocation is still the second most common complication in total hip arthroplasties, following aseptic loosening. It appears in 0.3–10% of primary hip arthroplasties and in up to 28% of revision arthroplasties.<sup>1</sup>

There are various classifications of THA dislocation; according to the time: early (<3 months) and belated (>3 months); according to their number: simple or recurrent; according to their direction: anterior (clinical observation of the affected limb in external rotation and extension) and posterior (lower limb in internal rotation and flexion); according to the mechanism of the lesion: traumatic or spontaneous; according to the etiology, following the Dorr classification,<sup>2</sup> which is important as knowledge of the cause of dislocation will help to decide the therapeutic attitude (positional: no radiographic alteration of components without soft tissue imbalance [10%]; malposition of components [33%]; imbalance of soft tissues: musculature, major trochanter, offset, [33%]; combination of II and III).

On the other hand, the risk factors considered associated to a greater probability of prosthetic dislocation have been extensively studied; factors relating to the patient such as age, gender, cognitive or neuromuscular alterations, initial diagnosis, prior surgery; factors related to the surgical procedure, such as approach routes, characteristics of

the components, pre- and postoperative radiographic measurements. However, there is still significant controversy surrounding many of them.

Considering the high incidence of dislocation in total hip arthroplasties and the lack of consensus in relation to some of the risk factors that favor it, this clinical-computational research work is designed with the following objectives: *clinical*: to determine the risk factors associated to prosthetic dislocation and categorize them by order of relevance, and *computational*: to simulate a prosthetic model with different sizes of components and their maximum ranges of movement before the impingement between components and dislocation takes place, in addition to correlating the computational with the clinical findings to determine the safe ranges of movement in each angulation and anteversion of the cup.

**Materials and methods****Clinical study****Population and sample**

We collected the episodes of dislocation of the THA diagnosed and treated at our center since 1994 until 2011. A total of 2227 arthroplasties were implanted in this period, of which 1338 were cemented, Exeter-Müller model, and 889 were uncemented, Zweymüller model, which as of 2004 was called SL-Plus.

A total of 46 patients, 35 cases with Exeter-Müller and 11 with Zweymüller/SL-Plus, suffered a prosthetic dislocation, so they comprised the group of cases.

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