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ORIGINAL PAPER

Do large femoral heads reduce the risks of impingement in total hip arthroplasty with optimal and non-optimal cup positioning?

Gianluca Cinotti · Niccolò Lucioli · Andrea Malagoli · Carlo Calderoli · Ferdinando Cassese

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Abstract The purpose of this study was to assess whether large femoral heads (36–38 mm) improve the range of motion in total hip arthroplasty compared to standard (28–32 mm) femoral heads in the presence of optimal and non-optimal cup positioning. A mathematical model of the hip joint was generated by using a laser scan of a dried cadaveric hip. The range of motion was assessed with a cup inclination and anteversion of reference and with non-optimal cup positions. Large femoral heads increased the range of motion, compared to the 28-mm femoral head, in the presence of a hip prosthesis correctly implanted and even more so in the presence of non-optimal cup positioning. However, with respect to the 32-mm femoral head, large femoral heads showed limited benefits both in the presence of optimal and non-optimal cup positioning.

Introduction

Large femoral heads have been introduced aimed at increasing the range of motion and reducing the risk of impingement and dislocation. This assumption is the result of clinical studies showing a reduced incidence of dislocations by increasing the diameter of the femoral head from 22 to 32 mm [1–3]. As a consequence, 22-mm femoral heads have become less and less popular in the last decade while 28- and 32-mm femoral heads have become the most frequently used. More recently, 36- and 38-mm femoral heads have been introduced to further reduce the risk of impingement and dislocation. These large femoral heads could theoretically improve the range of motion of the total hip to such an extent that, even when the positioning of the components is suboptimal, an impingement between the femoral neck and the liner should rarely occur.

Although the use of 36- and 38-mm femoral heads has rapidly increased in recent years, few studies have analysed the advantage of such implants compared to standard (28–32 mm) femoral heads [4, 5], and almost no study has assessed whether such potential advantages persist, or are even magnified, in the presence of a non-optimal cup positioning. In our investigation we assessed whether, and to what extent, a large femoral head improves the range of motion in the total hip arthroplasty with different cup orientations.

Material and methods

A mathematical model of the pelvis and the femur was generated using a laser scan of a dried cadaveric hip joint belonging to the Department of Human Anatomy.

A Real Scan USB 300 (3D Digital Corporation, Sandy Hook, USA) with an accuracy of 125 μ was used for laser scanning. The software included Rapid Form 2004 (INUS Technology Inc., Seoul, Korea) to create and manage the surfaces and Rhinoceros 3D 3.0 (Seattle, USA) to optimise the patch surface. The model was fixed on a rotating support, not subjected to vibrations, and 25 scans were performed for the pelvis and 43 for the femur.

Once the laser scans were performed, the final model was created through the recomposition and stratification of the images previously elaborated. In order to reduce the so-called "step" effect, a mean smoothing value of 0.5 was applied.

G. Cinotti (✉) · N. Lucioli
Orthopaedic Department, University La Sapienza,
Rome, Italy
e-mail: md3581@mclink.it

A. Malagoli · C. Calderoli · F. Cassese
DTM Technologies,
Modena, Italy

F. Cassese
e-mail: fcassese@dtm.it