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Update article

Total hip arthroplasty: a still evolving technique☆

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ABSTRACT

It has been advocated that total hip arthroplasty (THA) is probably the most successful surgical intervention performed in Medicine. In the 1960s, Sir John Charnley not only introduced, but also modified and improved the technique of cemented arthroplasties. The concepts on biological fixation established by Pillar and Galante served as the foundation for the development of uncemented implants that are now used worldwide. Currently, THA is a worldwide widespread surgery performed on millions of people. However, keeping abreast of the large number of information available on these procedures, especially on implant fixation, designs, different tribological pairings, and the long-term results can be challenging at times. This article is a brief update on the main aspects of THA.

Atualização em artroplastia total de quadril: uma técnica ainda em desenvolvimento

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RESUMO

A artroplastia total do quadril (ATQ) é uma das cirurgias de maior sucesso na história da medicina. Nos anos 1960, *Sir* John Charnley introduziu e aperfeiçoou as artroplastias cimentadas. Pillar e Galante estabeleceram os conceitos da fixação biológica, base para o desenvolvimento das artroplastias não cimentadas. Atualmente, a ATQ é uma cirurgia mundialmente difundida e feita em milhões de pessoas. No entanto, o grande número de

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informações disponíveis sobre as artroplastias, especialmente quanto à forma de fixação do implante ao osso, aos diferentes *designs* das hastes e dos acetábulos, aos diferentes pares tribológicos e aos resultados no longo prazo por vezes dificulta a tomada de decisão. Este artigo é uma breve atualização sobre os principais aspectos da ATQ.

Introduction

Hip arthroplasty is considered one of the major advances in the treatment of orthopedic diseases, and one of the most performed surgeries in the world.[1] Due to rapid recovery and return to most activities of daily living, it is considered one of the few medical procedures that benefit the patient as a whole, and the operation with best results in orthopedics.[2]

The basis of this surgery dates back to the end of the 19th century, when Themistocles Gluck demonstrated the tolerance of the human body to foreign bodies. Smith-Petersen, in 1923, *apud* Callaghan et al.,[3] developed studies with prosthesis coated with glass, bakelite and synthetic resins, and Philipe Wiles, in 1938, elaborated the concept of the first THA.

Sir John Charnley was responsible for the great progress of THA,[4] who developed the concept of low friction arthroplasty by the use of femoral heads with 22 mm of diameter, and the association of high molecular weight polyethylene with methyl methacrylate, with this latter material being used under the influence of Leon Wiltsie apud Charnley.[5] There has been a growing search to improve cementation quality. Krause et al.[6] developed the low viscosity cement; Harris et al.[7] described techniques to improve cementation, and Lee et al.[8] emphasized the importance of cement pressurizing.

For a long time, the failures of arthroplasties and large osteolyses were attributed to bone cement, and were called "cement disease". This has motivated several researchers to develop uncemented prostheses.

Bobyn et al.[9] and Galante[10] introduced the concepts of uncemented arthroplasties, had press fit and bone integration as forms of fixation between the bone and the implant. This mode of fixation is known as biological fixation. Several other authors have proposed and introduced prosthetic materials, devices and designs to facilitate biological fixation.

Despite the success of this surgery, the search for its improvement and better results, especially long term results continues, mainly in the development of new surfaces, materials with greater biocompatibility, and less aggressive surgery techniques.

Access routes

THA begins with the selection of the type of approach. The main access routes are the posterior, anterolateral and lateral ones.

The posterior approach, also called Moore's approach, is currently the most widely used. This route was popularized due to the ease of exposure of the acetabulum and femoral canal. In addition, there is no interference with the hip abductor (gluteus medius muscle), and it also shows a lower prevalence of deep vein thrombosis (DVT).[11] There is a greater theoretical potential of dislocation, and more difficulty in measuring lower limbs length. In the literature, the risk of instability is controversial, which can be minimized by reinsertion of the posterior capsule.[12,13]

The classical anterior approach was described by Smith-Petersen[14] and O'Brien.[15] One of its positive issues is that it does not violate tendons and muscles insertions. However, in patients with anatomical changes, it can be more difficult. There is a risk of injury to the lateral cutaneous nerve of the thigh. More recently, the concepts of the previous approach have been adapted to a new form, the anterior right approach. This route would have a lower theoretical risk of dislocation of the arthroplasty. Its more widespread use implies the need for angular (offset) femoral and acetabular drills, the traction table and a long learning curve.[16]

The lateral or Hardinge[17] approach has as a strong argument the ease for implant placement and, theoretically, a lower risk of instability. It was the main approach to the hip for a long time. However, there is the possibility of injury to the insertion of the abductor muscles. In some cases, partial detachment of the gluteus medius muscle is necessary for better exposure. This may cause limping due to deficiency of the abductive musculature, that is transient in most cases.

Types of implants and tribologic pairing

Basically, implants can be divided into two groups: the cemented and non-cemented ones. This division represents the different ways of implant fixation to the bone, with the main difference being the presence or absence of bone cement (polymethylmethacrylate – PMMA).

The cemented implants use the interposition of PMMA between bone and implant. PMMA modulus of elasticity is very close to that of the bone (cement modulus of elasticity ±2 GPa versus ±0.5–1 GPa of trabecular bone), and is resistant to compressive forces, but not to strain or shear forces.[18]

The long-term result of cemented arthroplasties depends on the quality of acetabular and femoral cementation. This fixation technique underwent several stages of evolution. In the first-generation cementation, the cement was placed manually, pressurized with the finger, there was no distal femoral cement restrictor for use during hip arthroplasty, and cement mixing was manually performed. The second-generation cementation was made with the use of a pistol for retrograde filling of the femoral canal; the use of a distal femoral cement restrictor was also initiated with the objective of creating a barrier, and favoring PMMA interdigitation through pressurization increase.[19] In the third generation, special