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Original Article

Radiographic evaluation of cementation technique using polished, conical, triple-tapered femoral stem in hip arthroplasty☆

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ABSTRACT

Objective: To radiographically evaluate the quality of cementation and implantation technique using a polished, triple-tapered femoral stem in total hip arthroplasty (THA).
Method: Retrospective study with radiographic evaluation of 86 hips in 83 patients who underwent to primary THA with the triple-tapered cemented femoral stem C-Stem (DePuy Orthopedics, Warsaw, Indiana). Cases with at least one-year of follow-up were included, and data related to preoperative, immediate postoperative, and late postoperative radiographic evolution were recorded. This study analyzed, among others, the proximal femoral anatomy, the quality of cementation as described by Barrack, and the implant positioning. Cementation was also evaluated and quantified in the Gruen zones with one-year of follow-up.
Results: The mean age was 62.85 years. Proximal femoral anatomical conformation was Dorr type A in 34 (39.53%) cases, type B in 52 (60.46%), and no type C cases were found. Five (5.81%) cases were defined as type A by Barrack's cementation classification system, 46 (56.49%) type B, 27 (31.40%) type C, and eight (9.30%) type D. The greatest cement mantle thickness was observed in zones four (15.53 mm) and 11 (15.64 mm), and the smallest in zone nine (3.51 mm). Positioning in varus was observed in eight (9.3%) cases, valgus in 25 (29%), forward deviation in two (5%), and backward deviation in 55 (63.95%).
Conclusions: The C-Stem femoral system presented satisfactory results related to cementation pattern, positioning, osteolysis, and stress shielding with regard to literature referring to double-tapered or triple-tapered models, demonstrating to be a safe method, with a predictable and reliable cementing pattern.

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Avaliação radiográfica da técnica de cimentação com haste femoral cônica polida e tripla cunha em artroplastia do quadril

Palavras-chave:
Artroplastia de quadril
Cimento ósseo
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Próteses de quadril

RESUMO

Objetivo: Avaliar radiograficamente a qualidade da técnica de cimentação e implantação de hastes femorais polidas e tripla cunha em artroplastias totais do quadril (ATQ).
Método: Estudo retrospectivo com avaliação de radiografias de 86 quadris em 83 pacientes submetidos à ATQ com componente femoral cimentado polido em tripla cunha C-Stem (DePuy Orthopaedics, Varsóvia, Ind.). Incluímos casos com pelo menos um ano de seguimento, foram registrados dados relacionados à evolução radiográfica pré-operatória, pós-operatória imediata e pós-operatória tardia. Avaliamos, entre outros dados, a anatomia do fêmur, a qualidade da cimentação segundo descrito por Barrack e o posicionamento da haste. A cimentação também foi avaliada e quantificada em cada zona de Gruen com um ano de seguimento.
Resultados: A idade média foi de 62,85 anos. A conformação do fêmur proximal foi do tipo A de Dorr em 34 (39,53%) casos, tipo B em 52 (60,46%) e não foram observados casos do tipo C. Cinco (5,81%) casos foram definidos como tipo A segundo a classificação de cimentação de Barrack, 46 (56,49%) tipo B, 27 (31,40%) tipo C e oito (9,30%) tipo D. A maior espessura média do manto foi observada nas zonas 4 (15,53 mm) e 11 (15,64 mm), a menor foi na zona 9 (3,51 mm). Foi observado posicionamento em varo em oito (9,3%) casos e em valgo em 25 (29%).
Conclusão: A haste femoral C-Stem apresentou resultados satisfatórios quanto ao padrão de cimentação, posicionamento, à presença de osteólise e *stress shielding*, tanto em relação à literatura referente aos modelos em dupla cunha quanto referente ao mesmo modelo de implante, mostrou-se um método seguro e com padrão de cimentação previsível e confiável.

Introduction

John Charnley was responsible for the success in the evolution of cemented total hip arthroplasty (THA). During years of study, changes in prosthetic models have been made to decrease the incidence of failures such as loosening, wear, stem ruptures, and stress shielding. Single-plane simple-shaped femoral stems have been replaced by biconic or triconic forms, and porous stems by polished versions; these changes allow better distribution of axial load and better adaptation or accommodation within the cement mantle.[1]

The concept of conical and polished rods is based on the theory that smooth surfaces with double (two-way) or triple (three-way) tapering maintain a less rigid relationship between implant and cement, allowing secondary migration and stabilization, without creating excessive stress.[2]

Cemented femoral components present some advantages in relation to the cementless ones, such as better transmission of loads in the proximal femur (greater similarity between the cement and the bone elasticity coefficient),[3,4] which allows its remodeling. Bone resorption secondary to stress shielding leads to a decrease in cementless prosthesis survival,[5,6] particularly at the calcar level.[7] Although it occurs more commonly in cementless implants, bone resorption has also been demonstrated in cemented stems,[8,9] with greater loss in Gruen et al. zones 1 and 7 of.[10] Another advantage is the low rate of femoral fractures during surgery (around 1% in cemented and 6.6% in non-cemented reconstructions).[11] Nonetheless, the rate of satisfactory results is directly proportional to the quality of the cementing technique, such as the maintenance of a mean cement mantle thickness between 2 and 4 mm, which avoids both brittleness and excessive stress.[12]

This study aimed to evaluate the quality of the cementation and implantation techniques of the C-Stem femoral stem (DePuy Orthopedics, Warsaw, Indiana). It is a conical, polished stem with a wedge shape, made of nitrogenated stainless steel, in which the distal migration within the cement mantle is predicted, with secondary stability.[13]

Material and methods

This was a retrospective study that assessed radiographs of 86 hips in 83 patients who underwent total hip arthroplasty with the C-Stem cemented femoral component. The sample was selected by six orthopedic surgeons specializing in hip surgery during their training stage. Consecutive patients who attended outpatient follow-up visits from January 2010 to March 2015 were included, provided they had a minimum one year follow-up.

The exclusion criteria comprised patients without records of preoperative and/or postoperative radiographs, imaging with inadequate technique, previous surgery on the same hip, and cases where manual cementation techniques were used. The radiographs were evaluated in two views: anteroposterior, centered in the pubic symphysis and with the hips at