Orthopaedics & Traumatology: Surgery & Research 101 (2015) 283–287

Available online at
ScienceDirect
www.sciencedirect.com

Elsevier Masson France
EM|consulte
www.em-consulte.com/en

Original article

Bone density and functional results after femoral revision with a cementless press-fit stem

F. Canovas[a,*], O. Roche[b], J. Girard[c], F. Bonnomet[d], M. Goldschild[e], P. Le Béguec[f]

[a] *Département de chirurgie orthopédique, unité de chirurgie du membre inférieur, hôpital Lapeyronie, CHU de Montpellier, 371, avenue du Doyen-Gaston-Giraud, 34295 Montpellier cedex, France*
[b] *Centre chirurgical Emile-Gallé, 49, rue Hermite, 54000 Nancy, France*
[c] *Hôpital Roger-Salengro, CHU de Lille, 2, avenue Oscar-Lambret, 59037 Lille cedex, France*
[d] *Hôpital de Hautepierre, CHU de Strasbourg, avenue Molière, 67098 Strasbourg cedex, France*
[e] *Polyclinique Sévigné, rue du Chêne-Germain – Z.A.C.-de-Coësmes, BP 67, 35512 Cesson-Sévigné cedex, France*
[f] *11, Galeries du théâtre, 35000 Rennes, France*

ARTICLE INFO

Article history:
Received 29 September 2014
Accepted 27 January 2015

Keywords:
Femoral implant
Review
Cementless stem
Press-fit
Bone density

ABSTRACT

Introduction: The influence of radiographic bone density changes in the area surrounding a total hip arthroplasty (THA) revision with a cementless press-fit stem is unknown, notably in terms of functional results. We have therefore conducted a study aiming to (1) propose a radiographic method to assess bone density, (2) measure the functional effects of reduced bone density, and (3) determine the factors contributing to these modifications.
Hypothesis: A reduction in radiographic bone density has a negative influence on the functional result after revision using a cementless press-fit stem.
Material and methods: We retrospectively assessed 150 THA revisions at a mean follow-up of 6.3 ± 3.2 years (range, 2–15 years). The clinical assessment was based on the Harris Hip Score. Bone density modifications were measured radiographically and the method was evaluated. The change in bone density was classified into two groups: (1) bone density not reduced or < 2 Gruen zones (118 cases [79%]); (2) bone density reduced ≥ 2 zones (32 cases [21%]). The variables showing a potential influence were the Cortical Index (CI), the type of primary stability with the press-fit system, and the femoral implant length.
Results: Inter- and intraobserver reliability of radiographic bone density measurement was evaluated as moderate or good (Kappa, 0.58; 0.60 and 0.67, respectively). For the Harris Hip Score at follow-up, there was a borderline statistical relation between stages 1 and 2: for the 118 stage 1 patients, this score was 83.62 ± 11.54 (range, 27–99) versus 78.34 ± 15.98 (range, 62–91) for stage 2 patients ($P = 0.09$). A CI ≤ 0.44 showed mediocre bone quality contributing to decreased bone density ($P < 0.02$). On the other hand, there was no statistically significant relation with the type of primary fixation ($P = 0.34$) or the length of the implant ($P = 0.23$).
Conclusions: A cementless revision femoral stem can induce a reduction in bone density with possible functional effects. The negative role played by bone scarcity on the functional score is confirmed, and even though the difference is not statistically significant, we suggest using a short stem when this is possible.
Level of evidence: Level IV, historical series.

1. Introduction

The femoral implant can be revised using a first-line cementless femoral stem, a distal interlocking prosthesis in cases with isthmic lesions, a "fit and fill" prosthesis with extended porous coating [1], or a press-fit implant [2] stabilized by creating pressure greater than the destabilizing forces at the bone–implant interface.

All cementless concepts can induce a reduction in bone density qualified as "stress shielding" by Engh et al. [3]. The authors who have evaluated this [1,4,5] underscore the absence of a functional effect of this bone density reduction, maintaining that it is not clinically significant. This can be contested and we believe it is

* Corresponding author. Tel.: +33 6 84 04 12 69.
E-mail address: f-canovas@chu-montpellier.fr (F. Canovas).

http://dx.doi.org/10.1016/j.otsr.2015.01.009
1877-0568/

pertinent to check whether a reduction in bone density can have an influence on the functional result after femoral revision with a cementless press-fit stem.

The objectives of this study were to:

- propose a radiographic assessment of the changes in bone density and to verify its reliability;
- evaluate whether reduced bone density has a functional effect;
- determine the main factors contributing to a decrease in bone density.

We hypothesized that radiographically assessed bone density reduction has a negative influence on the functional result.

2. Patients and methods

2.1. Patients

This retrospective study investigated a continuous series of 183 total hip arthroplasties performed between 1996 and 2000. Ten patients who had died (6%) were excluded, six patients (3%) were lost to follow-up, and 17 patients (9%) questioned only by telephone were autonomous and without pain. In the end, 150 protheses (82%) in 143 patients (seven bilateral revisions) underwent complete radiological and clinical assessment by an observer who was not involved in the surgeries (MG), at a minimum of 2 years follow-up. There were 74 females and 69 males (59 left hips and 91 right hips). The mean age was 68.9 ± 9.1 years (range, 27–89 years) and the mean follow-up was 6.3 ± 3.2 years (range, 2–15 years).

The causes for revision were: 79 cases of aseptic femoral implant loosening (53%), 47 extensive femoral granulomas (31%), 21 cases of cup loosening with femoral revision to change the bearing components (14%), two periprosthetic fractures, and one case of femoral stem breakage.

According to Della Valle and Paprosky [6], bone loss was stage 1 for 55 cases (37%), stage 2 for 32 cases (22%), stage 3A for 38 cases (26%), stage 3B for 21 cases (14%), and stage 4 for two cases (1%). The two periprosthetic fractures were excluded from this classification.

For 20 patients (13%) this was the second occurrence of loosening and for four patients (3%) the third revision. The explanted femoral stem was cemented in 140 cases (93%) and 19 cups were not changed.

2.2. Surgical technique

All surgeries were performed by a single operator (PLB). The approach to the joint was anterolateral in 26 cases and posterolateral in 124. The original components were removed via the endofemoral approach in 46 cases (31%) and with femorotomy using a lateral semicircular trochanteric-diaphyseal flap in 104 cases (69%), if necessary associated with osteotomy of the medial cortex to extend the primary stability that originally was only diaphyseal. No bone grafting was necessary. The implant was a right cementless femoral stem, conical and modular (Revitan™, Zimmer, Warsaw, IN, USA), in titanium alloy with a finely sanded surface, osseointegratable over its entire length. In the recovery period, partial weightbearing was allowed for 2 weeks.

2.3. Evaluation method

Bone density was radiographically analyzed immediately after the revision surgery and at the last follow-up, with a standard or negative AP X-ray. This comparative analysis consisted in locating demineralized areas characterized by, at the last follow-up, attenuation or disappearance of cortical trabeculations and, for borderline cases, performing a numerical evaluation of the gray level intensity [2]. All the demineralized areas, with or without decreased cortical thickness, were taken into account and classified according to how extensive they were and taking the Gruen zones as reference [7]. Zone 7 was included in zone 6 and cases of cortical necrosis were excluded from the study. Two stages were distinguished: stage 1, bone density not decreased or < 2 zones (Fig. 1) and stage 2, bone density reduction ≥ 2 zones (Figs. 2 and 3).

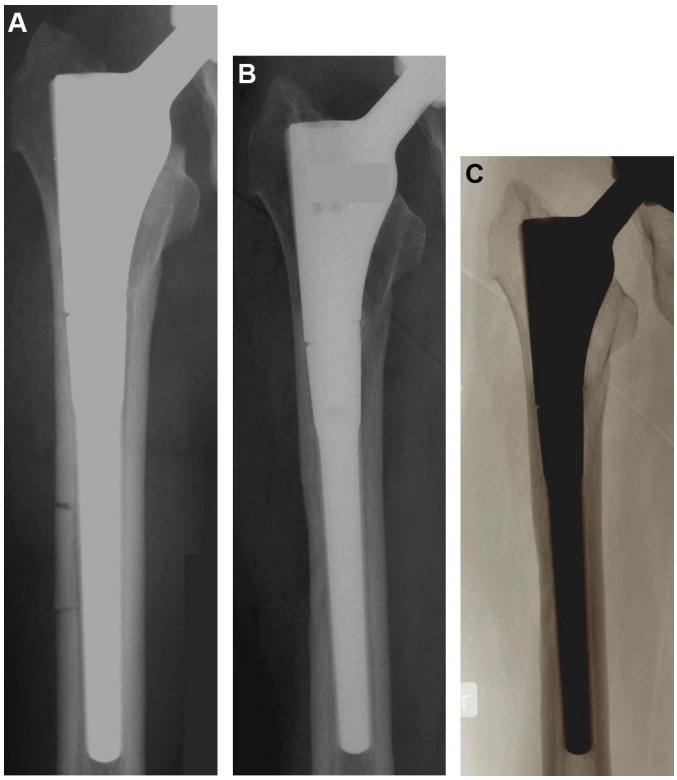

Fig. 1. Stage 1 bone density reduction. A. A 66-year-old female patient, global press-fit stem. B. At the 6-year follow-up, the cortical thickness not modified but proximal femur bone density decrease < 2 zones. C. Bone density reduction more visible on negative X-ray.

The preoperative and follow-up clinical assessment were based on the Harris Hip Score [8] and compared in terms of bone quality as well as the type of primary stability and implant length:

- bone quality was assessed using the Cortical Index (CI), which adds the median and lateral cortical thickness divided by the diameter of the diaphysis. This was a preoperative measurement taken in the isthmic area, outside the loosening area. This index was deemed very good, CI ≥ 0.55, in 30 cases (20%); good, CI between 0.45 and 0.54, in 46 cases (31%); moderate, CI between 0.35 and 0.44, in 56 cases (37%); poor, CI ≤ 0.34, in 18 cases (12%);
- the type of primary press-fit fixation was defined based on the immediate postoperative X-ray by the femur area where there was bicortical bone–implant contact. The primary fixation was proximal in 13 cases (9%), global in 53 cases (35%) (17 via the endofemoral approach and 36 extension with flap), diaphyseal in 46 cases (31%), and with three-point contact in 38 cases (25%);
- three implant lengths were distinguished: short stems (< 200 mm) in 31 cases, long stems between 200 and 250 mm in 60 cases, and extra-long stems (> 250 mm) in 59 cases.