The Journal of Arthroplasty xxx (2017) 1–5

Contents lists available at ScienceDirect

The Journal of Arthroplasty

journal homepage: www.arthroplastyjournal.org

Original Article

Modular Neck vs Nonmodular Femoral Stems in Total Hip Arthroplasty—Clinical Outcome, Metal Ion Levels, and Radiologic Findings

Rasmus T. Mikkelsen, MD [a, *], Marianne Fløjstrup, MD [b], Christian Lund, DC [b], Per Kjærsgaard-Andersen, MD [a], Thomas Skjødt, MD [b], Claus Varnum, MD, PhD [a]

[a] Section for Hip and Knee Replacement, Department of Orthopaedic Surgery, Vejle Hospital, Vejle, Denmark
[b] Department of Radiology, Vejle Hospital, Vejle, Denmark

ARTICLE INFO

Article history:
Received 12 January 2017
Received in revised form
17 March 2017
Accepted 30 March 2017
Available online xxx

Keywords:
THA
modular neck
corrosion
pseudotumor
pain

ABSTRACT

Background: Modular neck femoral stem (MNFS) for total hip arthroplasty (THA) was introduced to optimize the outcome, but created concerns about pain, elevated blood metal ion levels, and adverse reaction to metal debris such as pseudotumors (PTs), related to corrosion between femoral neck and stem. We compared these outcomes in patients with MNFS or nonmodular femoral stem (NFS) THA.
Methods: Thirty-three patients with unilateral MNFS THA were compared with 30 patients with unilateral NFS THA. Levels of pain, serum cobalt, serum chromium were determined. Magnetic resonance imaging was performed to describe PT and fatty atrophy of muscles.
Results: The MNFS and NFS group had a mean follow-up of 2.3 and 3.1 years, respectively. Four and 13 patients in the MNFS and NFS group had pain, respectively ($P = .005$). The MNFS group had higher levels of serum cobalt ($P < .0001$) and chromium ($P = .006$). PTs were present in both the MNFS (n = 15) and NFS (n = 7) groups ($P = .066$). PTs were related to serum cobalt ($P = .04$) but not to pain or serum chromium. Fatty atrophy prevalence in the piriformis and gluteal muscles were higher in patients with MNFS ($P = .009$ and $P = .032$, respectively).
Conclusion: More patients in the NFS group had pain. Serum cobalt and chromium levels were higher in the MNFS group. Prevalence of PTs was twice as high in the MNFS group, but the difference was insignificant.

In the late 20th century, manufacturers of total hip arthroplasties (THAs) introduced a new design: the modular neck femoral stem (MNFS). It had the intention of giving the surgeon the possibility to restore the patients' anatomy more accurately in terms of neck anteversion, leg length, and femoral offset. Stryker Orthopaedics (Mahwah, NJ) had shown great result with the conventional ABGII nonmodular femoral stem (NFS) [1], which led to the introduction of the ABGII MNFS in 2009. However, the implant was recalled in 2012 by the manufacturer because of concerns about formation of pseudotumors (PTs) and elevated blood metal ion levels [2–7] that might be linked to neurologic and cardiac diseases in patients with MNFS [8,9]. Duwelius et al [10] and Carothers et al [11] found no difference in neck anteversion, leg length, femoral offset, Harris hip score, or Short Form 12-item score between MNFS and NFS THAs, which indicate that MNFS poses an unnecessary risk for the patients. Although originally related to metal-on-metal THAs and later MNFS THAs, case reports about PTs in conventional metal-on-polyethylene NFS THAs have been published [12–14]. However, no study in MNFS THAs has included a control group. This makes it difficult to assess whether patients with an MNFS THA have more pain, higher blood metal ion levels, and more pathologic magnetic resonance imaging (MRI) findings than patients with conventional NFS THA. Therefore, we aimed to perform a cohort study comparing prevalence of pain, levels of serum cobalt and serum chromium, and prevalence of adverse reaction to metal debris, such as PTs, in both MNFS and NFS THAs.

One or more of the authors of this paper have disclosed potential or pertinent conflicts of interest, which may include receipt of payment, either direct or indirect, institutional support, or association with an entity in the biomedical field which may be perceived to have potential conflict of interest with this work. For full disclosure statements refer to http://dx.doi.org/10.1016/j.arth.2017.03.072.

* Reprint requests: Rasmus T. Mikkelsen, MD, Section for Hip and Knee Replacement, Department of Orthopaedic Surgery, Vejle Hospital, Kabbeltoft 25, DK-7100 Vejle, Denmark.

http://dx.doi.org/10.1016/j.arth.2017.03.072
0883-5403/

Materials and Methods

This prospective cohort study was conducted at a single center. We identified all patients operated with ABGII MNFS in our institution: From January 2009 to January 2012, 4 surgeons operated 53 patients with a primary unilateral THA with the ABGII MNFS. The patients were given an MNFS instead of the conventional ABGII NFS if the surgeon peroperatively found that it was impossible properly to restore the patients' anatomy with the NFS. All patients were operated through a posterolateral approach and had the Trident acetabular cup, a highly cross-linked polyethylene X3 liner, and a 36-mm LFIT cobalt-chromium femoral head (Stryker Orthopaedics, Mahwah, NJ). The neck part of the ABGII MNFS was made of cobalt-chromium and the stem part was made of titanium.

Of the 53 patients with MNFS, 13 patients were excluded (8 had a contralateral THA before inclusion, 3 did not want to participate, and 2 had died). The remaining 40 MNFS patients were matched with 40 patients who were unilaterally operated with the ABGII NFS in the same period at our institution. The patients were matched on gender, age at surgery, date of surgery, wear surface, and size of the femoral head. Age at surgery was defined as ±10 years, and date of surgery was defined as ±1.5 months. Before MRI scans were performed, 5 patients were excluded owing to contraindications of MRI scans; 1 was excluded because of a periprosthetic femoral fracture, and 1 was excluded because of failure to obtain clinical data. Another 10 patients were excluded before serum cobalt and serum chromium levels were determined because they had at that point been operated with another THA on the contralateral side. In total, 63 patients were included, 33 patients in the MNFS group and 30 patients in the NFS group (Fig. 1).

Before primary THA, the Harris hip score was determined for all patients. At follow-up, patients were clinically examined, and the Harris hip score was determined. Pain was registered as any degree of pain patients reported at the first question in the Harris hip score. All patients had serum cobalt and serum chromium levels determined in nmol/L. Blood samples were analyzed in our local laboratory according to the procedure defined in the Danish Orthopaedic Society follow-up program for metal-on-metal THAs. In this follow-up program, serum level of cobalt >119 nmol/L and serum level of chromium >134.5 nmol/L are seen as elevated, and if environmental exposure to cobalt and chromium is excluded, revision surgery can be considered [15].

PT was defined as any mass, solid or cystic, in continuity of the joint (Fig. 2A, B). We graded PTs according to the Hauptfleisch PT classification system [16]. The prevalence of joint effusion >1 cm, bone marrow edema, trochanteric bursitis, and hip abductor tendon tear were measured. We assessed fatty atrophy in the gluteal, piriformis, and iliopsoas muscles (Fig. 3A, B) as described by Pfirrmann et al [17]. The MRI scanner was Philips 1.5 Tesla, and the protocol for metal artifact reduction software was used. The protocol consists of a transversal T1-weighted sequence, a coronal T1-weighted sequence, a coronal T2-weighted, and a coronal short tau inversion recovery sequence. The MRIs were evaluated by one radiologist and one chiropractor with 20 and 4 years' experience,

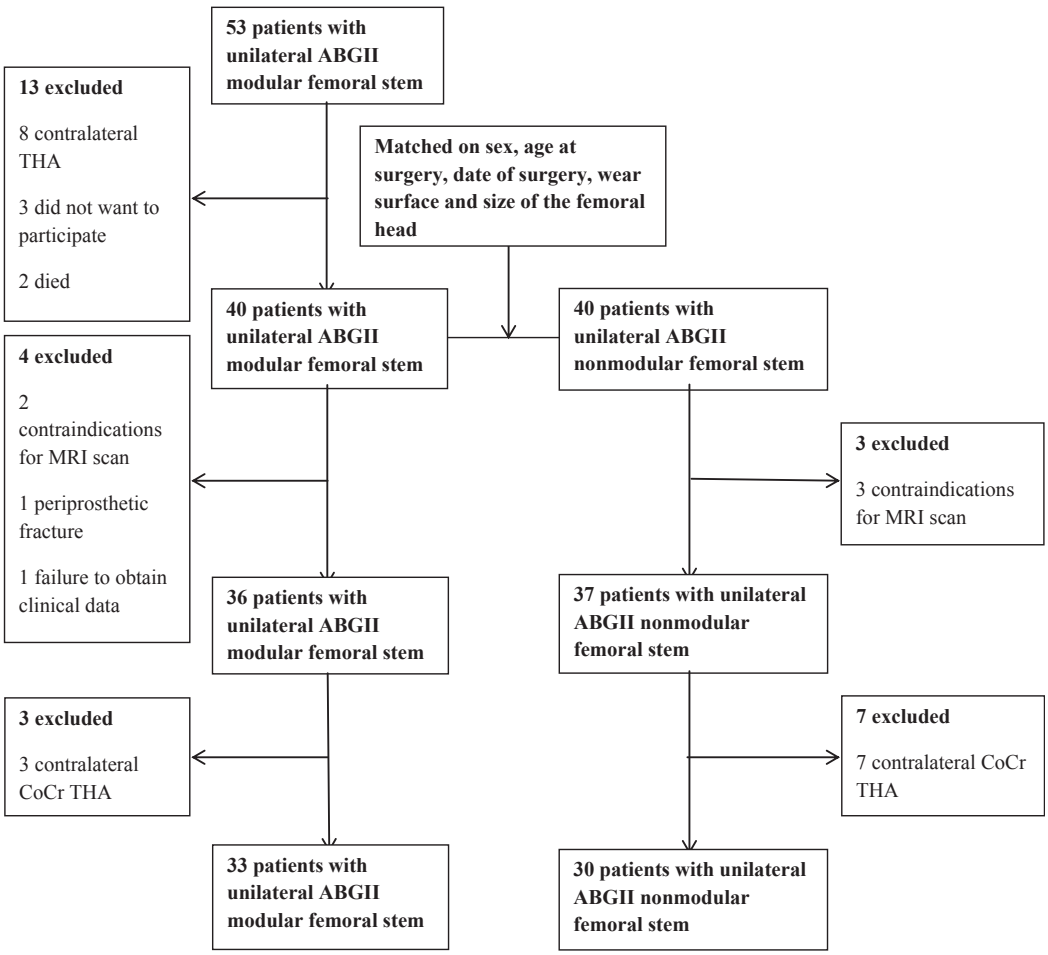

Fig. 1. Flowchart of inclusion and exclusion of patients. CoCr, cobalt-chromium; MRI, magnetic resonance imaging; THA, total hip arthroplasty.