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Long-Term Results Using the Straight Tapered Femoral Cementless Hip Stem in Total Hip Arthroplasty: A Minimum of Twenty-Year Follow-Up

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ABSTRACT

We report the first long-term results of a prospective cohort study after total hip arthroplasty using the cementless Bicontact hip stem. Between 1987 and 1990, 250 total hip arthroplasties in 236 patients were performed using the cementless Bicontact hip stem. The average follow-up was 22.8 years (20.4–24.8) and average age at index surgery was 58.1 years. Eighty-one patients died and 9 were lost to follow-up. We noted 11 stem revisions revealing an overall Kaplan Meier survival rate of 95.0% (CI 95%: 91.1–97.2%). The average Harris Hip Score revealed 81 points (range 24–93). The Bicontact hip stem demonstrated high survival rates despite high ages and osteopenic changes, which are equivalent to other long-term reports of cementless stem fixation.

Osteoarthritis of the hip joint (OA) can be treated successfully by total hip arthroplasty (THA) leading to an improvement of hip function and patients quality of life [1,2]. About 20% of all patients undergoing THA are younger than 60 years [3]. Therefore THA studies exceeding a follow-up of 20 years are of special interest. Survival rates of 88–98% of cementless hip stems have been reported with follow up periods of 15–20 years [4–17]. Acetabular shells and polyethylene materials used in these studies have been often discontinued, partially changed or improved over time due to high rates of acetabular component failures with polyethylene wear and osteolysis. However, especially cementless titanium hip stems used in these studies remained often unchanged or only partially changed for additional sizes or femoral offsets and represent examples of the clinically successful second generation of contemporary hip stems [18]. Some of these hip stems are also well documented in joint arthroplasty registers [6,19,20]. With reference to previous studies [16,21] and a hip stem design and surface coating unchanged since time of introduction in 1987, only extended by increased femoral offset stems in the year 2000, we report the updated prospective follow-up results of 250 cementless straight titanium alloy hip stems with proximal plasmaspray surface with a minimum follow-up period of 20 years.

Patients and Methods

The Bicontact femoral component (B.Braun-Aesculap, Tuttlingen, Germany) has been used in our institution since June 1987. The first consecutive 250 cementless implantations from June 1987 to March 1990 in 236 patients are included in this prospective nonrandomized study. The current study received ethics committee approval.

In total, 250 total hip arthroplasties in 236 patients were performed with the cementless Bicontact hip stem with an average age of 58.1 years at time of index surgery (range 20.3–84.3 years). There were 49% men and 51% women. 52% affected the right and 48% left hips.

No preoperative selection of the arthritis entity was performed resulting to patients with any condition requiring THA being included in this prospective cohort study. The primary indication distribution was idiopathic osteoarthritis in 62.0%, dysplasia in 16.8%, acute instable femoral neck fracture in 9.2%, avascular necrosis of the femoral head in 8.4%, posttraumatic osteoarthritis in 2.4%, and rheumatoid arthritis in 1.2%. In 12.4% of the hips previous surgical interventions had been performed including osteotomies or open reduction and internal fixation of acetabular or proximal femur fractures. Every patient gave informed consent.

The femoral component is a straight collarless stem made of forged titanium alloy according to ISO 5832–3. A microporous, pure titanium surface is applied on the proximal stem region by a plasmaspray technology (Plasmapore, pore sizes 50–200 μm) (Fig. 1). The geometry of the proximal stem section features a broad medial fixation surface, curved anterior and posterior support flanges, and a lateral antirotation wing. The distal tapered part of the stem is smooth and uncoated. In addition an uncoated femoral stem for cemented

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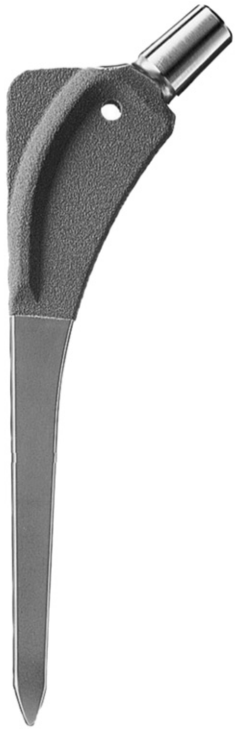

Fig. 1. Bicontact stem (B.Braun-Aesculap, Tuttlingen, Germany).

implantation is available. Instruments and operative technique are similar for both modes of fixation. The decision whether or not to use cement can be made intraoperatively by selecting an uncoated prosthesis for cemented or a proximally coated stem for cementless fixation. The femoral component was combined with different acetabular implants from the same manufacturer, thereof in 65.6% of cases a cementless threaded acetabular cup and in 34.4% a cemented all-poly cup were implanted. Conventional polyethylene inserts and cups, gamma-sterilised in N2 inert gas atmosphere – already available at that time – and 32 mm cobalt-chrome femoral heads have been used in all cases.

Patients with any condition requiring THA were selected, including those with an acute fracture of the femoral neck. The operations have all been performed in a standardized lateral transgluteal approach according to Bauer in supine position [22]. Femoral preparation required two different special designed femoral preparation instruments series with increasing sizes, identified as A- and B-osteoprofilers. A-osteoprofilers are designed to compress the trochanteric cancellous bone with the aim to preserve bone, rather than removing it. The stepwise compacted cancellous bone enhances the proximal stem press fit anchorage conditions. Subsequent B-osteoprofilers are finally introduced to cut the medial prosthetic bed, the support of the bilateral anterior and posterior flanges and the seating of the rotation wing in the intertrochanteric bone. This final preparation step provides an exact fitting shape in the compressed bone to provide primary proximal implant stability. As the femoral bone preparation was the same for cementless and cemented stem implantation the decision for stem selection was made intraoperatively before insertion of the stem. Cementless implantation was performed in about 40% of patients undergoing hip arthroplasty at that time, and a prospective series of cemented implantation with 250 consecutive patients was recruited parallel to this series of uncemented implantation [23]. According to standardized postoperative THA therapy standards end of the 80-ties in our institution postoperative aftercare involved partial weight bearing of 20 kg for six weeks. The use of crutches for the first 3 months was encouraged. No prevention of heterotopic ossifications (irradiation or application of drugs) was instituted at that time. Patients were invited for continuous prospective clinical assessment and radiologic examination.

The current study was conducted with a minimum follow-up of 20 years after implantation. Follow up included a clinical examination of the Harris Hip Score (HHS) [24] and the Hannover Function Score (HFS) (Kohlmann et al 1996). X-ray controls included projections in anteroposterior and lateral planes, which have been compared to the available previous projections to objectivise possible loosening or late onset of migration. These serial x-ray controls were surveyed for stem position (neutral, valgus, or varus), subsidence, radiolucent lines, bone hypertrophy, osteolysis and heterotopic ossifications. Subsidence was calculated by measurements using the characteristic edge on the medial side of the stem and the tip of the minor trochanter on actual radiographs compared with direct postoperative baseline films and the following serial controls. Radiolucent lines were classified into those less than 2 mm or more than 2 mm and allocated to Gruen zones I through VII [25]. As the distal part of the investigated hip is not intended for bone ingrowth, the term radiolucent line in the Zones III–VI in ap view in this article is identical to the reactive line (less than 2 mm) of Engh et al [26]. Changes in bone density were assessed by visual analysis. Stress shielding is defined according to Engh et al [27]: Only second-, third-, and fourth degree stress shielding with resorption of cortical bone medially, anteriorly, or laterally was regarded as stress shielding, whereas rounding off of the medial femoral neck was noted as calcar rounding and not considered a sign of stress shielding. Osteolyses or femoral endosteal cavitations [28] are defined as areas of localized loss of trabecular bone or localized cortical erosion [29]. Pedestal forming is defined as a shelf of endosteal new bone partially or completely bridging the intramedullary canal in an apparent attempt to support the tip of the prosthesis [26]. Heterotopic ossifications were rated according to Brooker et al [30]. Loosening has been defined as radiolucent lines >2 mm around

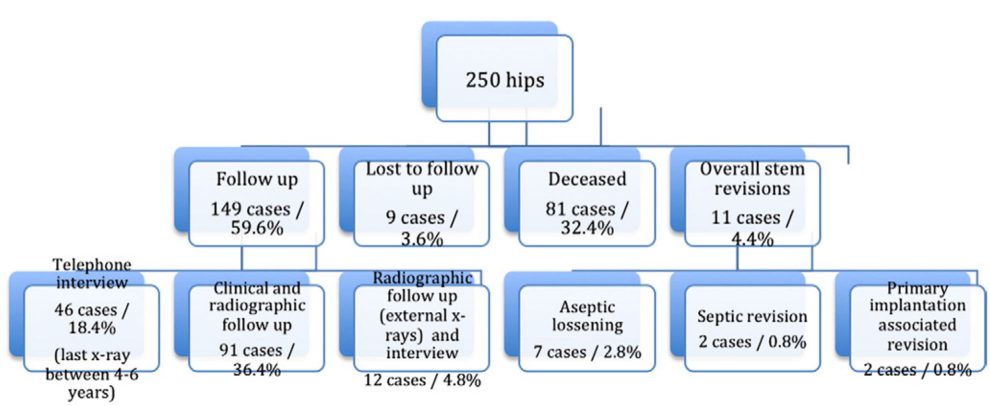

Fig. 2. Overview of the follow up.