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A Case Series of Total Hip Arthroplasty Using Cementless Hip Stem Customized for Patients of a Specific Race: 10- to 15-Year Results

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ABSTRACT

We report a minimum of 10-year results of patients undergoing total hip arthroplasty (THA) using the cementless BiCONTACT N stem, which was developed to fit the femur in a specific race in which the predominant etiology of hip diseases was developmental dysplasia. A total of 108 hips were evaluated with a mean follow-up of 11.9 ± 1.4 years. The etiology for THA was secondary osteoarthritis due to developmental dysplasia in 90.3% of patients. No evidence of aseptic loosening of the BiCONTACT N stem was observed. The survivorship with the end point as revision surgery for any reason was 94.4% (95% confidence interval 88.7%–97.3%) at 15.0 years postoperatively. BiCONTACT N stem may be an effective alternative for patients with developmental dysplasia of the hip.

The etiology for total hip arthroplasty (THA) varies among ethnic groups [1]. Although primary osteoarthritis is a common etiology for THA in North America, Northern Europe, and Scandinavia, the predominant etiology of Japanese hip diseases is secondary osteoarthritis due to developmental dysplasia of the hip [2]. Hips with developmental dysplasia are likely to show considerable alteration of femoral morphology, including a narrow femoral canal, low offset, and high anteversion of the femoral neck [3].

The initial stability of a cementless hip stem can affect mid-term and long-term results of THA. However, standard cementless hip stems may not obtain the intended initial stability for patients with atypical femoral morphology. To resolve this issue, Dohmae and Blömer developed the BiCONTACT N (Narrow) stem (B. Braun Aesculap, Tuttlingen, Germany) for Japanese patients [4]. The BiCONTACT N stem was not a whole new prosthesis. The unique feature of the BiCONTACT N stem was customizing the successful hip stem (BiCONTACT STD [Standard] stem, former model of the existing BiCONTACT S [Standard] stem), which had already been reported to show good mid-term results [4,5]. All previous mid-term or long-term follow-up results of THA using the BiCONTACT stem showed a very low rate of revision due to aseptic loosening of the hip stem [5–7].

The BiCONTACT stem was designed to fit the femur at the proximal part of the stem with the curve of the proximal-medial aspect of the stem and fins placed anteriorly, posteriorly, and laterally (Fig. 1) [8]. The shape of the cross-section at the distal part of the BiCONTACT stem is rectangular, like that of the Zweymüller stem, which was designed to fit the distal part of the femur [9]. Thus, the BiCONTACT N stem may fit the femur at the distal part of the stem, despite the concept of fitting the femur at the proximal part of the stem.

The aim of this study was to investigate the minimum 10-year results of THA using the BiCONTACT N stem. We tested the following two hypotheses: (1) no aseptic loosening of femoral stem would occur in THA using the BiCONTACT N stem; (2) bone reaction on X-ray would suggest that the BiCONTACT N stem fitted the femur at the distal part of the stem.

Materials and Methods

This case series was initiated following institutional review board approval. Patients undergoing THA from January 2000 to December 2004 were eligible for inclusion, providing a minimum follow-up duration of 10 years. We retrospectively reviewed our institutional database by searching for all patients undergoing THA during the study period. With use of the same database, we previously reported the follow-up results of patients receiving THA using ceramic-on-ceramic bearing couples [10].

Patients who received a cementless BiCONTACT N stem were included in this study. Patients receiving other hip stems were excluded.

We chose the cementless BiCONTACT stem as the first-line choice for patients scheduled for THA during study period. The choice of S, SD (Small Diameter), or N types was dependent on the shape of the proximal medullar cavity. For patients with severe osteoporosis, cemented prostheses were used to obtain initial stability.

Surgery was performed using a posterior approach with the patient in the lateral decubitus position. The posterior joint capsule was

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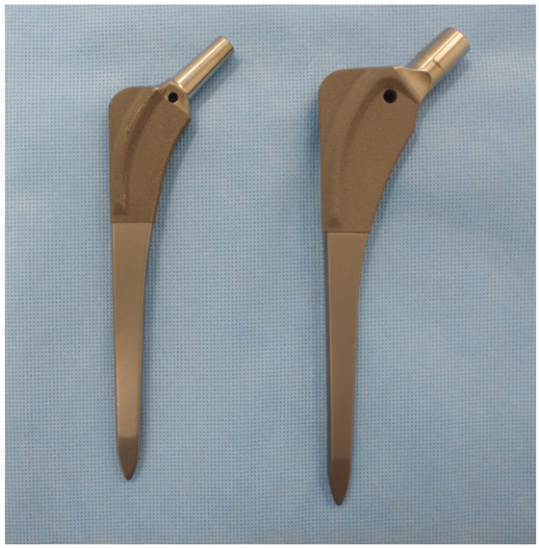

Fig. 1. BiCONTACT N (Narrow, left) and S (Standard, right) of the same stem size. The stem size was determined as the mediolateral width 6 cm proximal from the distal end.

routinely excised during the study period. The incised short external rotators were reattached to the greater trochanter. For patients with superolateral acetabular bone defect, we performed bulk bone autografting from the femoral head or femoral neck, as described previously [11]. The decision to perform bulk bone autografting was determined by preoperative anteroposterior supine pelvic X-ray and confirmed by intraoperative findings.

Intravenous antibiotic prophylaxis with a first-generation cephalosporin was administered perioperatively and every 8 hours for the first 48 hours postoperatively. Clinical and radiographic evaluations were performed every year.

Primary Outcome

The primary outcome was aseptic loosening of the hip stem. We reviewed all X-rays taken at the final follow-up, and categorized stem fixation as bone-ingrown, stable fibrous, or unstable according to the definitions of Engh et al [12]. Subsidence in vertical distance of >4 mm or a change in varus angle >2° was considered to indicate an unstable hip stem [13]. One author (ST) who was not the operating surgeon in this case series evaluated the X-rays twice with a 2-month interval and agreement was assessed.

Secondary Outcome

Kaplan–Meier survivorship with 95% confidence interval was determined with the end point as revision for any reason.

Clinical assessment was performed using the Merle d'Aubigne and Postel hip score, with a maximum score of six points for pain, mobility, and gait function [14].

Any other complications until the final follow-up of the patients were reviewed with clinical records and radiographic studies.

Radiographic outcome, including cortical hypertrophy and stress shielding of the femur, was evaluated. Cortical hypertrophy was defined as fusiform enlargement of the cortical bone. The region of hypertrophy was recorded according to the Gruen zone [15]. Stress shielding was categorized into four degrees of severity according to Engh et al [16]: first degree was a rounding off of the proximal medial edge of the cut femoral neck; second degree was rounding off of the proximal medial femoral neck combined with loss of medial cortical density at Gruen zone 7; third degree was more extensive resorption of cortical bone, typically involving both the medial and anterior cortical regions at Gruen zone 7 and the medial cortex at Gruen zone 6; and fourth degree was cortical resorption extending below Gruen zone 6 into the diaphysis.

Statistical Analysis

The intraobserver agreement for stability of the BiCONTACT N stem was evaluated using the weighted Cohen kappa coefficient. The data are presented as the estimate and accompanying 95% confidence interval. The kappa values were interpreted as follows: 0, poor agreement; 0–0.20, slight agreement; 0.21–0.40, fair agreement; 0.41–0.60, moderate agreement; 0.61–0.80, substantial agreement; and 0.81–1.0, almost perfect agreement [17].

Kaplan–Meier survivorship with 95% confidence interval was determined with the end point as revision surgery for any reason.

All statistical analyses were performed with R (The R Foundation for Statistical Computing) and EZR (Saitama Medical Center, Jichi Medical University, Saitama, Japan) [18].

Results

Patients

A total of 184 THAs were performed during the study period. The BiCONTACT N stem was used in 134 of these 184 THAs (72.8%) during the study period. Table 1 shows the patient demographics and diagnosis data. The predominant diagnosis was osteoarthritis secondary to hip dysplasia. To augment the acetabular bone defect, bulk femoral head bone autografting was performed in 26 hips and femoral neck autografting was performed in two hips.

Primary Outcome

X-rays of 108 hips (80.6%) could be evaluated for more than 10-year follow up postoperatively. In these hips, the mean follow-up period was 11.9 ± 1.4 (range, 10.0–15.0) years. Fig. 2 outlines the patient flow diagram.

No evidence of loosening of the hip stem was observed until the final follow-up. A total of 106 hips were classified as bone-ingrown stable, and two were classified as stable fibrous.

The interobserver agreement at 2-month intervals was moderate with a kappa value of 0.49 (95% confidence interval, −0.11 to 1.0).

Secondary Outcome

The survivorship with the end point as revision was 94.4% (95% confidence intervals 88.7%–97.3%) at 15.0 years (Fig. 3). A total of seven patients (seven hips) had component revisions. Three patients had

Table 1
Patient Demographics and Diagnoses.

Variable	Value
Gender	
Female	118
Male	16
Age (y)[a]	61.4 ± 10.4 (35–84)
Height (cm)[a]	153.6 ± 8.1 (130–176)
Weight (kg)[a]	56.3 ± 8.5 (40–80)
Body mass index[a]	23.9 ± 3.8 (16.6–40.2)
Diagnosis	
Osteoarthritis secondary to hip dysplasia	121
Primary osteoarthritis	1
Posttraumatic osteoarthritis	1
Osteonecrosis of femoral head	11
Bearing couple	
Ceramic on ceramic	90
Ceramic on polyethylene	29
Metal on polyethylene	15

[a] Values are expressed as means ± standard deviation, with ranges in parentheses.