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Does the Canal Fill Ratio and Femoral Morphology of Asian Females Influence Early Radiographic Outcomes of Total Hip Arthroplasty With an Uncemented Proximally Coated, Tapered-Wedge Stem?

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ABSTRACT

Background: Noncement femoral fixation in total hip arthroplasty (THA) has been gaining popularity. However, owing to the numerous varieties of uncemented stems and differing types of femoral stem morphology, it is unclear whether the clinical outcomes of all uncemented stems are equal. The aim of this study was to investigate the relationships between canal fill ratio and femoral morphology and early radiologic outcomes in Japanese patients who underwent THA with an uncemented proximally hydroxyapatite-coated, tapered-wedge stem.

Methods: We retrospectively reviewed 103 patients who had undergone THA using a single proximally coated tapered-wedge stem. The relationships between canal fill ratio and femoral morphology and early radiologic outcomes after THA with those stem were investigated.

Results: Eighty-one hips were analyzed after inclusion and exclusion criteria were applied. Failed osteointegration proximally was observed in 4 hips (4.9%). Canal flare index was significantly greater in hips with failed osteointegration than in those with successful osteointegration ($P = .009$). Distal hypertrophy was observed in 14 hips (17.3%). Proximal-distal matching ratio was significantly lower in hips with distal hypertrophy than in those without ($P = .01$). Canal fill ratio at 2 cm above the lesser trochanter was smaller in hips with failed osteointegration and distal hypertrophy than in those without ($P = .02$).

Conclusion: Suboptimal radiologic changes were seen with greater distal fill with smaller proximal fill and with a narrow femoral canal. It is important to select the stem that can achieve the original concept of intended primary and secondary fixation areas.

Although the superiority of uncemented over cemented stems in total hip arthroplasty (THA) has not been demonstrated, uncemented femoral fixation has been gaining popularity worldwide [1-3]. Most studies have demonstrated excellent survivorship with uncemented stems [1-3]. Although a few complications specific to uncemented stems (eg, thigh pain, intraoperative fracture, and postoperative subsidence) must be overcome, the advantages of an uncemented stem seem to outweigh the disadvantages. However, because there are many varieties of uncemented stems in terms of design, surface coating quality, and coating area, it is unclear whether the clinical outcomes of all uncemented stems are equal [4]. In addition, the femur has many anatomic variations [5,6]. Because adequate initial fixation and secondary osteointegration are important to the success of an uncemented stem, variations in femoral morphology and stem design may influence the outcome.

The Accolade TMZF Femoral Stem (Stryker Orthopaedics, Mahwah, NJ), an uncemented tapered-wedge design, was introduced to provide more physiologic loading of bone by improving initial fixation with a proximal hydroxyapatite (HA) coating (PureFix HA Coating; Stryker Orthopaedics) [7]. Ideally, this proximally HA-coated stem achieves initial fixation at the femoral metaphysis, and the tapered-wedge design does not require distal fixation. However, in a departure from the original design concept,

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in some patients, the proximally HA-coated tapered-wedge stem is fixed at the distal end ("distal fixation or proximal-distal mismatch") [8]. Cooper et al reported that unfavorable radiologic outcomes demonstrating failed osteointegration at the proximal coating area were associated with greater canal fill distally. Although several authors have shown excellent survivorship, including 99.4% survival in 222 patients for aseptic loosening at 5 years [1-3,9], fixation that deviates from the original concept may lead to rare, potentially undesirable radiologic outcomes in some patients [8]. In particular, it is well known that proximal femoral morphology differs between Asian and Western populations; therefore, its effect on outcomes in Asian populations should be considered [6]. We hypothesized that the canal fill ratio of the Accolade stem and femur morphology would influence radiologic outcomes. The aim of this study was to investigate the relationships between canal fill ratio and femoral morphology and early radiologic outcomes in Japanese patients who underwent THA with an uncemented proximally HA-coated, tapered-wedge stem.

Materials and Methods

Patients

After obtaining institutional review board approval, we retrospectively reviewed the medical records of all patients who had undergone THA at our university hospital between May 2011 and May 2013. One hundred three patients who had undergone THA using a single proximally coated tapered-wedge stem were identified. Exclusion criteria were (1) femoral neck fracture; (2) previous femoral osteotomy surgery (it was thought these patients might have abnormal bone quality and shape); and (3) male patients.

Operative Procedure

All surgeries were performed by a group of 4 orthopedists specializing in hip joint arthroplasty. A standardized protocol was used throughout the preoperative, perioperative, and postoperative course. All patients were encouraged to ambulate, weightbearing as tolerated, starting the first postoperative day. A direct anterior approach or a posterior approach was used, which reflected a change in operative technique by 1 surgeon toward the end of the study period. In both approaches, femoral fixation was obtained using a hand-broached press-fit technique that required no reaming. In the posterior approach, after inserting the stem, the optimal stem was checked by x-ray intraoperatively, and adjustments were made. In the anterior approach, to decrease the effect of learning curve, an expert of anterior approach participated to the all operation, and the stem was inserted under fluoroscopy assist.

Implant Data

The Accolade TMZF stem (Stryker Orthopaedics) was used in all patients. This stem is made from a titanium alloy and has a proximal circumferential plasma spray that features a 50-μm-thick PureFix HA Coating (Stryker Orthopaedics) and a distal matte finish.

Radiographic Assessments

Radiographic evaluation of femoral morphology was performed immediately preoperatively and 2 weeks postoperatively. Anteroposterior x-rays of the hips by the standardized technique were performed with the patient in supine position. Preoperative radiographs were used to analyze proximal femoral geometry using previously described radiographic parameters (Fig. 1), including

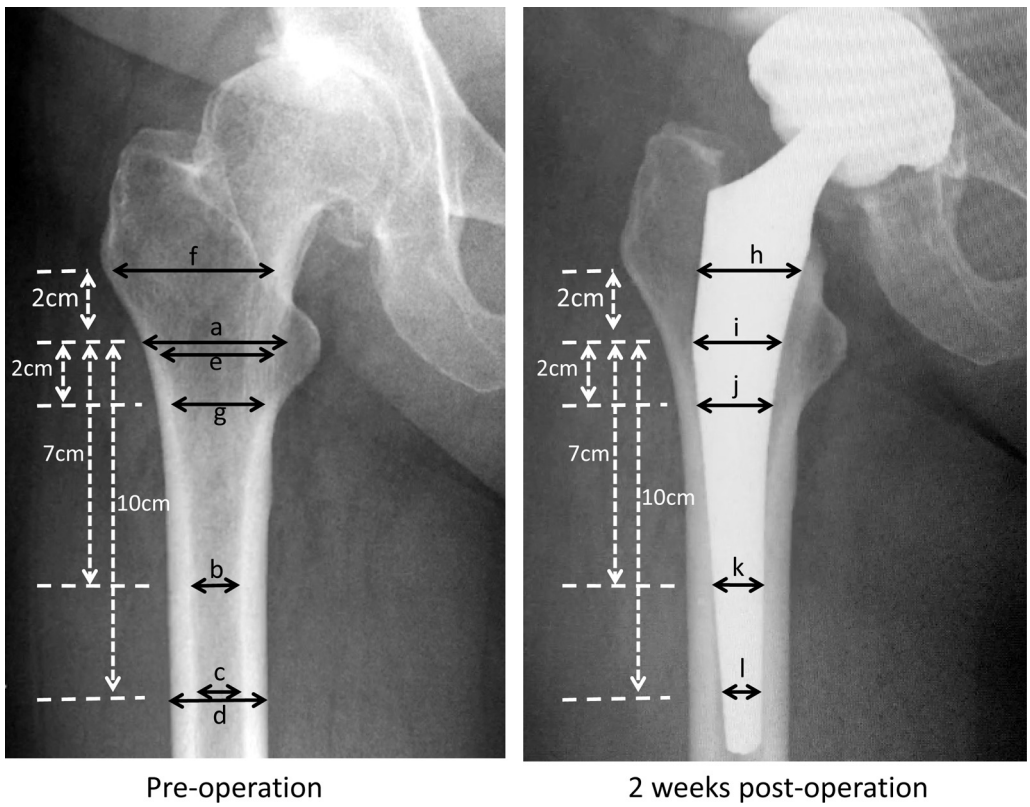

Fig. 1. The relationships between canal fill ratio and femoral morphology and early radiologic outcomes after 91 total hip arthroplasties with an uncemented proximally HA-coated, tapered-wedge stem. HA, hydroxyapatite.