Preservation of Acetabular Bone Stock in Total Hip Arthroplasty Using Conventional vs. Robotic Techniques: A Matched-Pair Controlled Study

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INTRODUCTION

Primary total hip arthroplasty (THA) is a common procedure, with 332,000 procedures performed in 2010, in the United States alone[1]. Kurtz et al. projected an increase of 572,000 primary THAs per year by 2030, and a twofold increase by 2026 is expected in revision THA[2]. Increases for THA in younger patients (< 60 years), as a consequence of preexisting hip disorders, account for almost 40% of THA procedures completed in the United States [3,4]. This produces a challenge, as it has been shown that younger age at the time of the primary THA corresponds to increased risk of revision THA[5]. Numerous studies report primary THAs in patients younger than 30 years with global revision rates ranging from 4% to 33%. These reported rates are much higher than those reported for older patients (range, 7%-15%) with a longer follow up[6]. Preservation of acetabular bone during primary total hip arthroplasty (THA) is important, because proper stability of cementless acetabular cup during primary THA depends largely on the amount of bone stock left after acetabular reaming. Eccentric or excessive acetabular reaming can cause soft tissue impingement, loosening, altered center of rotation, bone-to-bone impingement, intraoperative periprosthetic fracture, and other complications[7]. Furthermore, loss of bone stock during primary THA may adversely affect subsequent revision THA. The purpose of this study was to compare preservation of acetabular bone stock between conventional THA (CTHA) vs. robotic-guided THA (RGTHA). We hypothesized that RGTHA would allow more precise reaming, leading to use of smaller cups and greater preservation of bone stock.

METHODS

Patients who received RGTHA were matched to a control group of patients who received CTHA, in terms of pre-operative native femoral head size (47.8mm - 48.1mm), age (mean 56.9), gender, BMI, and approach. Acetabular cup size relative to femoral head size was used as a surrogate for amount of bone resected. We compared the groups according to three measures describing the acetabular cup diameter (c) in relation to the femoral head diameter (f). These three measures

were: (1) c-f, the difference between the cup diameter and femoral head diameter, (2) (c-f)/f, the same difference as a fraction of the femoral head diameter, and (3) (c^3-f^3)/f^3, the same ratio expressed volumetrically.

RESULTS

A total of 57 matched pairs were included in each group. There were no significant differences between groups in terms of gender, age at surgery, or BMI. No differences in femoral head diameter or acetabular cup diameter were observed between groups ($p > 0.05$). However, measure (2) (c-f)/f and (3) (c^3-f^3)/f^3 did differ significantly between the groups, with lower values in the RGTHA group ($p < 0.02$).

DISCUSSION

RGTHA allowed for the use of smaller acetabular cups in relation to the patient's femoral head size, compared to CTHA. Using acetabular cup size relative to femoral head size as a surrogate measure of acetabular bone resection, these results indicate that greater preservation of bone stock using RGTHA compared to CTHA. This may reflect increased translational precision during the reaming process. With the increasing number of young patients requiring primary THA places special attention on the need to preserve the maximum amount of bone stock, as the rate of acetabular revision is higher than the rate of femoral revisions[8-10]. However, further studies are needed to validate the relationship between acetabular cup size and loss of bone in THA.

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DISCLOSURE

Jennifer Christopher is an employee of Stryker Corp.

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