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Original Article

Favorable Results of Primary Total Hip Arthroplasty With Acetabular Impaction Bone Grafting for Large Segmental Bone Defects in Dysplastic Hips

Toshiki Iwase, MD, PhD *, Daigo Morita, MD, Tadashi Ito, MD, Genta Takemoto, MD, Kazuya Makida, MD

Department of Orthopedic Surgery, Hamamatsu Medical Center, Hamamatsu, Shizuoka, Japan

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ABSTRACT

Background: The aim of the present study was to assess midterm results after acetabular impaction bone grafting (IBG) in primary total hip arthroplasty (THA) for developmental dysplasia of the hip (DDH) with large acetabular segmental defect.
Methods: Primary THA with IBG for DDH with large acetabular segmental defect was performed in 40 hips of 38 patients. The average age was 61.6 years (range: 33-82 years), and the average follow-up period was 7.5 years (range: 3-10.3 years). The Merle d'Aubigné and Postel hip score and complications were assessed. For radiological assessment, postoperative location of the hip rotation center, the socket inclination angle, and the socket center-edge angle were assessed. Kaplan-Meier survival analysis was performed with the end points of any type of reoperation and aseptic acetabular loosening.
Results: The mean Merle d'Aubigné and Postel hip score improved from 10.4 points to 16.2 points at the final follow-up. Reoperation was performed in 1 case for acute infection without loosening. In 39 out of 40 hips (97.5%), the center of hip rotation was located beneath the "high hip center." The average socket inclination angle was 39.3° (range: 30°-54°), and the average socket center-edge angle was −11.8° (range: −23° to 9°). Survival rate of acetabular component at 8 years with the end point of any reoperation and of aseptic loosening was 96.6% (95% confidence interval: 89.9%-100%) and 100%, respectively.
Conclusion: Acetabular IBG represents one of the useful options for restoring a normal hip center and acetabular bone stock in primary THA for DDH with large acetabular defect.

Developmental dysplasia of the hip (DDH) is one of the challenging conditions for which primary total hip arthroplasty (THA) is performed. Deformed and/or dysplastic anatomic landmarks, such as superolateral bony wall defects, osteophyte formation, and the small anteroposterior diameter of the acetabulum, complicate the positioning and fixation of the socket in surgery [1].

Various surgical techniques using cementless sockets, such as an elevated hip center [2], with or without bulk bone grafts [3,4], or a medial protrusio technique [5], have been described; however, they may compromise reconstruction of the normal center of hip rotation [6]. Although, ultraporous metal cup and augments technique [7-9] have been developed recently, they still lack long-term results of large series and can not gain bone stock recovery.

Regarding cemented cups in THA for DDH patients, an autologous bulk graft is the most commonly used technique for bone stock recovery and reconstruction of the normal center of hip rotation, with favorable midterm and long-term outcomes being reported [10-16]. However, when coverage of the cemented cup by the graft exceeds 50%, the longevity of the cup may be compromised [11,12].

On the other hand, impaction bone grafting (IBG) is a widely accepted technique especially in European countries for acetabular reconstruction with large bone stock loss in revision and primary THA [17-23], and the postoperative longevity of the acetabular component with this technically demanding procedure is well documented in the literature.

We previously reported favorable midterm outcomes of acetabular revision with an IBG technique, particularly in simple segmental wall defect cases [23]. Based on this favorable

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* Reprint requests: Toshiki Iwase, MD, PhD, Department of Orthopedic Surgery, Hamamatsu Medical Center, 328 Tomitsuka-cho, Naka-ku, Hamamatsu, Shizuoka, 432-8580, Japan.

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preliminary experience, we started to perform acetabular IBG for primary THA in DDH cases with relatively large acetabular wall defects.

The aim of the present study is to assess midterm clinical and radiographical follow-up results at least 3 years after acetabular reconstruction in primary THA for DDH with large acetabular segmental bone defects.

Patients and Methods

This study was conducted with the approval of the Ethics Committee of our institution (approval number E 42/2015). A total of 344 hips from 294 patients underwent primary cemented THA for osteoarthritis at our institution between November 2004 and March 2012. All patients were Japanese. Because our concept for cemented cup positioning in THA is to target the true acetabulum with an operative cup inclination angle of 40° and operative anteversion of 20°, bone grafting to contain the cemented cup is essential if there is a large superolateral bone defect. Although a bulk bone graft, which was harvested from the resected autofemoral head, was applied if the graft did not cover the cup beyond the center of the femoral head, an IBG technique was indicated when the superolateral acetabular wall defect existed medially beyond the center of the femoral head.

Preoperative radiographic templating was the indicator of selection criteria for bone grafting method. In addition, the final decision whether bulk bone graft technique or IBG technique should be applied was made when trial acetabular cup was placed at the reamed true acetabulum position.

According to this indication for the bone grafting technique, acetabular IBG was performed on 40 hips from 38 patients of 344 hips from 294 patients, and all of these cases were followed up at least 3 years after surgery. There were 35 women and 3 men. The average age at surgery was 61.6 years (range: 33-82 years), and the average follow-up period was 7.5 years (range: 3-10.3 years). The degree of dislocation according to Crowe grouping was group I in 13 hips, group II in 15, group III in 11, and group IV in 1.

All surgeries were performed using a posterolateral approach. After an adequately trimmed X-change metal mesh (Stryker Benoist Girard, Herouville-Saint-Clair, France) was fixed with 3.5-mm cortical screws at approximately 1-cm intervals for segmental defect containment, morselized cancellous bone chips harvested from the patient's own resected femoral head or from an allograft were impacted into the acetabular cavity. In the present series, allograft was used in addition to the patient's own femoral head in 4 hips (1 hip both in Crowe group I and group II and 2 hips in group III) because of poor bone quality or small size of their femoral heads.

The cemented cup was inserted into the reconstructed dome at the true acetabular floor with a modern cementing technique. The cups used were the All-Polyethylene Acetabular Cup (Stryker Orthopaedics, Mahwah, NJ) in 18 hips, Contemporary Cup (Stryker Orthopaedics) in 21, and CLHO Cup (Kyocera Medical, Osaka, Japan) in 1. The stems used were the Exeter Universal stem (Stryker Orthopaedics) in all hips.

In the clinical assessment, the Merle d'Aubigné and Postel hip score [24] was assessed preoperatively and at the final follow-up. The degree of postoperative improvements was classified according to this method as a very good improvement, good improvement, fair improvement, and failure.

In the radiological assessment, anteroposterior radiographs of the bilateral hip joints were analyzed preoperatively and 1 month, 6 months, and every 6 months postoperatively thereafter. Radiographs were evaluated on a consensus basis by 3 authors. The following were analyzed using postoperative anteroposterior radiography: the height of the femoral head center of the hip measured perpendicular to the interteardrop line (y: Fig. 1); the horizontal location of the femoral head center as the distance along the interteardrop line from the inferior point of the teardrop (x: Fig. 1); the acetabular cup inclination angle between the horizontal line drawn through the interteardrop line and the cup wire marker (θ: Fig. 2); the socket center-edge (CE) angle described by Sugano et al [25] (α: Fig. 2). The mean acetabular cup inclination angle and socket CE angle were compared between lower subluxated cases of Crowe group I/II ($n = 28$) and higher subluxated cases of Crowe III/V ($n = 12$).

The presence of progressive interface radiolucent lines (RLLs) of >2 mm and osteolysis around the acetabular component zones

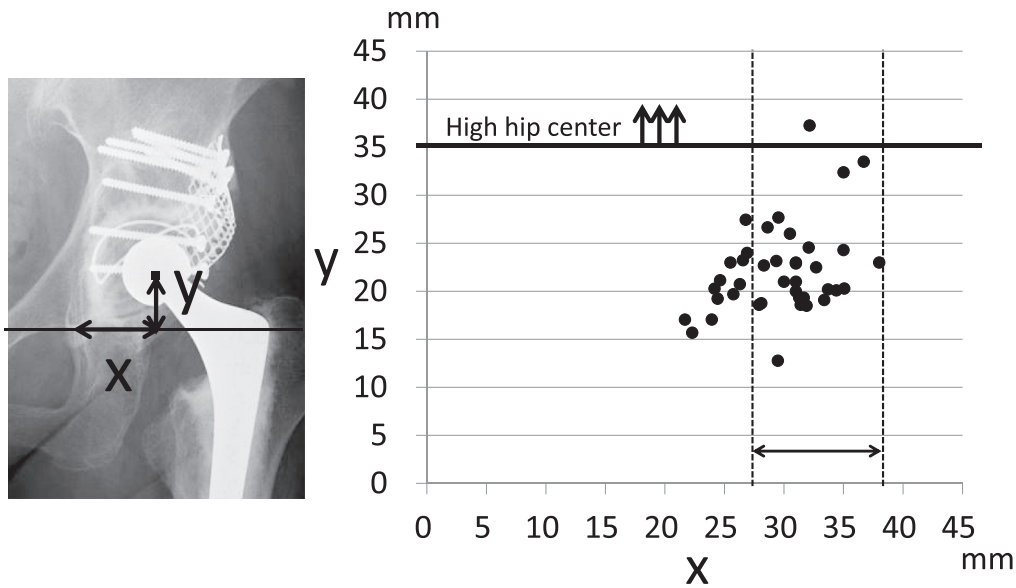

Fig. 1. A scattergram of the postoperative center of hip rotation. x: The horizontal location of the femoral head center from the ipsilateral teardrop on the interteardrop line. y: The height of the femoral head center perpendicular to the interteardrop line. A "high hip center" is defined as the height of the femoral head center being >35 mm. Dotted lines indicate the range of the average ± 2 standard deviations of the horizontal location of the femoral head center of normal Japanese women [30].