Mid-term results of acetabular reconstruction using a Kerboul-type acetabular reinforcement device

Junji Hori · Yuji Yasunaga · Takuma Yamasaki ·
Tomokazu Yoshida · Seigo Oshima ·
Keiichihiro Yamasaki · Toshihiro Matsuo · Mitsuo Ochi

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Abstract

Purpose The purpose of this study was to investigate the mid-term results of 32 acetabular reconstructions performed using a Kerboul-type acetabular reinforcement device and bone graft between June 1997 and January 2009.

Methods The mean age of the patients at the time of surgery was 71.4 years (range 55–85). Patients were followed-up for a mean of 7.5 years (range 2.1–13.7). The acetabular bone defects according to the American Academy of Orthopaedic Surgeons system was type III for 29 hips and type IV for three hips. Bulk allografts were performed in 30 hips and morselised autografts (iliac bone) were performed in two hips. Clinical evaluations were made according to the criteria of Postel/Merle d'Aubigné.

Results The mean pre-operative Postel/Merle d'Aubigné hip score was 7.0 ± 2.9 , and the final follow-up hip score was 12.6 ± 2.8 . Six hips showed radiographic loosening, and two hips required further revision. A Kaplan-Meier analysis showed that the five-year and ten-year survival rates were 96.9% and 92.3%, respectively, using further revision of the acetabular device as an end point.

Conclusion Acetabular reconstruction using a Kerboul-type acetabular reinforcement device and bone graft gives satisfactory mid-term results.

Introduction

The long-term results of total hip arthroplasty (THA) have improved due to advances in the prosthesis and surgical techniques [1–3]. However, the results of revision THA are uncertain, especially when there are large bone defects in the acetabulum or femur. The acetabular bone defects are usually repaired with an acetabular reinforcement device and bone graft [4–9]. Since 1997, we have used femoral head allografts as bulk grafts in combination with a Kerboul-type acetabular reinforcement device. The purpose of this study was to examine the mid-term results of this technique.

Materials and methods

Patients

We retrospectively reviewed 30 revision THA (29 patients) and two re-revision THA (2 patients) between June 1997 and January 2009. The mean age of the patients at the time of surgery was 71.4 years (range 55–85). All of the cases were female. The mean duration of follow-up was 7.5 years (range 2.1–13.7).

The initial diagnoses were osteoarthritis secondary to acetabular dysplasia in 23 hips, femoral neck fracture in five hips, rheumatoid arthritis in three hips, and systemic lupus erythematosus in one hip. The previous operations included 24 THA and eight bipolar hemiarthroplasties (BHA). The revision procedures were performed for aseptic loosening in all cases. Both acetabular and femur revision was performed in 18 hips, and only acetabular revision was performed in 14 hips. The acetabular bone defects were classified

J. Hori (✉) · T. Yamasaki · T. Yoshida · S. Oshima ·
K. Yamasaki · M. Ochi
Department of Orthopaedic Surgery,
Graduate School of Biomedical Sciences, Hiroshima University,
Kasumi 1-2-3, Minami-ku,
Hiroshima City 734-8551, Japan
e-mail: horijun919@yahoo.co.jp

Y. Yasunaga · T. Matsuo
Department of Artificial Joints and Biomaterials,
Graduate School of Biomedical Sciences, Hiroshima University,
Hiroshima, Japan

according to the American Academy of Orthopaedic Surgeons (AAOS) system [10]. Type III defects (combined segmental and cavitary) were present in 29 hips and type IV (pelvic discontinuity) in three hips.

A Kerboul plate [4] was used in 20 hips and a KT plate [6] in 12 hips. The KT plate is a modified Kerboul plate made of titanium with a similar shape. This plate has various types of offset and vertical length, and is commonly used for osteoarthritis secondary to acetabular dysplasia or large bone defects in the acetabulum. Bulk allografts were performed in 30 hips and morsellised autografts (iliac bone) were performed in two hips. The bulk grafts (plate-like, 8–10 mm in width) were prepared from a fresh-frozen femoral head which had been harvested during primary THA or BHA under sterile conditions and stored at -80°C ; they were used in a stack at the time of revision surgery. The post-operative management included partial weight bearing after two weeks and full weight bearing after eight weeks.

Assessment

The pre-operative and final follow-up clinical assessments were evaluated according to the criteria of Postel/Merle d'Aubigné [11] with scoring of pain, mobility of the hip, and walking. The post-operative and final follow-up radiographs were compared to evaluate the device loosening. Radiographic loosening was defined by the following three criteria: (1) the breakage or loosening of the screw or device, (2) a change of more than 3 mm in length in the acetabular device position or a change of more than 3° in the abduction angle of the device caused by horizontal or vertical migration [4, 12], and (3) a progressive radiolucent line of more than 2 mm in width in all three zones as defined by DeLee and Chanley [13]. The survival rate analysis was performed by the Kaplan-Meier method using radiographic loosening or the need for further revision of the acetabular device as an end point.

Statistical analysis

The pre-operative and final follow-up Postel/Merle d'Aubigné hip scores, migrations, and abduction angles of the acetabular devices were compared using the Wilcoxon signed-rank test. Statistical differences were considered significant for p -values <0.05 .

Results

Post-operative dislocation occurred in five hips, and a deep infection occurred in two hips treated with continuous irrigation. The pre-operative Postel/Merle d'Aubigné hip score was 7.0 ± 2.9 , and the final follow-up hip score was 12.6 ± 2.8 , which was significantly improved compared to the pre-operative score ($p < 0.01$). In particular, the pre-operative pain score (2.4 ± 1.4) was markedly higher than the final follow-up hip score (5.3 ± 1.1).

Six hips showed radiographic loosening (Table 1). Breakage of the screw was found in one hip, and breakage of the device was found in three hips. The mean change in the abduction angle of the device was $2.1 \pm 4.1^{\circ}$. Three hips showed more than 3° change of the angle. The mean horizontal migration of the device was 2.0 ± 3.1 mm, and the mean vertical migration was 2.0 ± 2.1 mm. Four hips showed a more than 3-mm change in the horizontal and/or vertical direction. There was no complete radiolucent line around the acetabular device in any patient. Two hips required further revision. One hip using a morsellised graft required revision because of the breakage of the device and recurrent dislocation, and one hip using a bulk graft required revision for destruction of the acetabulum after radiotherapy.

The five-year and ten-year survival rates were 83.3% and 78.7%, respectively, using radiographic loosening as an end point (Fig. 1). The five-year and ten-year survival rates were 96.9% and 92.3% using further revision of the acetabular device as an end point (Fig. 2).

Table 1 The cases of radiographic loosening

Case	Age (years)/sex	AAOS	Bone graft	Breakage		Change of device		Further revision
				Screw	Device	>3 mm	> 3°	
case 2	75/female	Type III	Morsellised	-	+	-	+	+
case 5	75/female	Type III	Bulk	-	-	+	+	-
case 8	55/female	Type III	Bulk	+	-	-	-	-
case 12	70/female	Type III	Bulk	-	-	+	+	+
case 17	64/female	Type III	Bulk	-	+	+	-	-
case 32	79/female	Type III	Bulk	-	+	-	-	-

Fig. 1 A Kaplan-Meier survival curve using radiographic loosening as an end point

Discussion

The presence of bone defects in the acetabulum or femur creates a problem in revision THA. Revision surgery in the acetabulum requires provision of support for the cup, to approximate the normal anatomy, and to restore the length of the lower limb [14]. The Kerboull-type acetabular reinforcement device is able to provide the bone graft with a mechanical support, without unloading it completely, because of the flexibility of the device [4]. This device follows the size and location of the acetabular bone defects as a guide, and provides the hip with an appropriate centre of rotation. For the AAOS type IV defects (pelvic discontinuity), this device can maintain the continuity of the pelvis.

When the bone defect in the acetabulum is large, a bone graft is used to restore the acetabular bone stock. Allografts are generally used in revision surgery because the quantity of autograft available is limited. Morsellised grafts are superior in terms of remodelling from the host bone compared to bulk grafts [15]. However, morsellised grafts have lower mechanical strength than bulk grafts, and breakage of the acetabular reinforcement device may

Fig. 2 A Kaplan-Meier survival curve using further revision of the acetabular device as an end point

appear before remodelling of the graft bone if morsellised graft is used. In fact, there have been several reports of the high failure rate of morsellised grafts for acetabular revision surgery [16, 17]. The failure rate has been reported to be 18% at seven years [18] and 23% at 6.3 years [8]. On the other hand, some reports have shown good results using morsellised grafts [5, 19, 20]. Therefore, the efficacy of using morsellised grafts is uncertain.

Kawanabe et al. compared the results of morsellised grafts and bulk grafts [7]. They reported that the survival rate of morsellised grafts and bulk grafts at ten years was 53% and 82%, respectively, using failure of the acetabular component whether revised or not as an end point. In our cases, the number of morsellised grafts was small (2 hips), but one of these hips required further revision due to breakage of the device. When the cases are limited to only bulk grafts in our study, the ten-year survival rates improved to 82.1% using radiographic loosening as an end point, and 96.7% using further revision of the acetabular device as an end point. We now use the bulk grafts with a Kerboull-type acetabular reinforcement device for large acetabular bone defects as the standard for revision THA (Fig. 3).

The use of bulk grafts may lead to good results, but the long-term results of using a bulk graft without an acetabular reinforcement device were poor. The failure rate has been reported to be 44% at 3.8 years [21] and 56% at 12 years [22]. Garbuz et al. reported that bulk allografts with an acetabular reinforcement device completely united to host bone and demonstrated no resorption at 7.5 years, in contrast, the failure rate was 28% in the cases without an acetabular reinforcement device [14]. The graft bone should be partially unloaded and protected from the mechanical stress until bone remodelling [4].

Fig. 3 Anteroposterior (AP) radiographs of a 73-year-old female who underwent revision total hip arthroplasty (THA) using a Kerboull plate and a bulk allograft. **a** Before revision surgery. **b** Two weeks after surgery. **c** 11 years after surgery with a stable reconstruction

In conclusion, acetabular reconstruction using a Kerboul-type acetabular reinforcement device and a bulk allograft provides satisfactory mid-term results in revision THA. Further follow-up will therefore be needed to confirm the long-term results.

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