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Original article

Clinical and radiographic evaluation of cemented socket fixation concomitant to acetabular bone grafting fixed with absorbable hydroxyapatite-poly-L-lactide composite screws

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ABSTRACT

Background: The durability of uncalcined and unsintered hydroxyapatite-poly-L-lactide composite screws is unclear when used for the fixation of acetabular bone graft in total hip arthroplasty under full-weight conditions. We have used this type of screw for the fixation of acetabular bone graft in cemented or reverse-hybrid total hip arthroplasty since 2003. Hence, we conducted a follow-up study to assess the safety and efficacy of these screws when used for cemented socket fixation.

Methods: In this study, 98 patients (106 cases) who underwent fixation of acetabular bone graft in cemented or reverse-hybrid total hip arthroplasty using hydroxyapatite-poly-L-lactide composite screws were followed up for over 5 years and evaluated clinically and radiographically. The patient population comprised 10 men and 88 women with a mean age of 60.3 years (range, 41–81 years) at the time of surgery. The original diagnosis for primary total hip arthroplasty was secondary osteoarthritis in 97 cases and high hip dislocation in nine cases.

Results: The mean follow-up period was 7.6 years (range, 5–11 years). No patient in this series required revision surgery, and no radiographical loosening occurred during the follow-up period. The mean Japanese Orthopaedic Association score improved from 48 (range, 7–73) preoperatively to 87 (range, 50–100) at the final follow-up. Radiographically bone graft consolidation was confirmed in all cases, and no apparent osteolysis around the cemented socket or composite screws was detected. Kaplan–Meier survival analyses with socket revision surgery for any reason, socket loosening, and appearance of a radiolucent line >1 mm in any zone as the endpoints yielded survival rates of 100%, 100%, and 86.8% at 5 years, and 100%, 100%, and 81.0% at 10 years, respectively.

Conclusion: This absorbable screw seems to have no negative effects on the mid-term clinical results of cemented socket fixation.

1. Introduction

Composite screws of uncalcined and unsintered hydroxyapatite (HA) particles and poly-L-lactide (PLLA) were developed as completely absorbable bone fixation devices [1,2]. They are commercially available as Superfixsorb or Osteotrans Plus (Takiron Co., Ltd., Osaka, Japan), and have been widely used in orthopedic, craniofacial, oral, maxillofacial, plastic, and reconstructive surgery since December 2003. We have used pure PLLA screws for fixation of acetabular bone graft in total hip arthroplasty (THA) since 1990. A previous long-term follow-up study on the use of pure PLLA for THA screws revealed good safety and efficacy outcomes [3]. However, in a previous series, postoperative gait exercise started 2–6 weeks after surgery with only one-third partial weight bearing allowed, and superior mechanical properties are desirable for fixation devices in weight-bearing conditions as an early rehabilitation program after THA [4]. Therefore, we developed mechanically stronger and bioabsorbable HA-PLLA composite screws [5,6], which can increase the initial stability of the grafted bone, and began using them frequently in 2003. In this study, to assess the safety and efficacy of these screws, we retrospectively evaluated the clinical and radiographic results of cemented socket fixation concomitant to acetabular bone grafting fixed with HA-PLLA composite screws.

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2. Patients and methods

All patients provided informed consent and the study protocol was approved by the Institutional Review Board of our hospital. Between December 2003 and January 2009, primary THAs were performed in 337 cases by several surgeons at our institution, in which 206 cement cups were used. Among them, acetabular bone grafting was performed in 136 cases in which the supero-lateral portion of the trial socket was outside the dysplastic acetabulum, and the defect was so large that it could be filled with bulk bone graft. The grafts were fixed with HA-PLLA composite screws in 114 cases, and temporal K-wire fixation in 22 cases. In the 114 cases (106 patients), one patient died of an unrelated disease and seven patients were lost to follow-up within 5 years. Finally, 106 cases (98 patients) were followed up for over 5 years and were reviewed retrospectively (follow-up rate, 93%). The patients comprised 10 men (10 cases) and 88 women (96 cases) with a mean age of 60.3 years (range, 41–81 years) at the time of surgery. Their mean body weight and body mass index (BMI) were 53.9 kg (range, 39.3–83.0 kg) and 23.0 kg/m^2 (range, 15.2–34.5 kg/m^2), respectively. The original diagnosis for primary THA was secondary osteoarthritis in 97 cases and high hip dislocation in nine cases.

Degree of subluxation was categorized according to the classification of Crowe et al. [7]; this series included 52 hips in group 1, 28 in group 2, 17 in group 3, and 9 in group 4. This series included 104 cemented THAs and two reverse-hybrid THAs. A cemented socket made of highly cross-linked, ultra-high-molecular-weight polyethylene (KYOCERA Medical Corporation, Osaka, Japan) was used in all cases. The mean socket diameter was 44.2 mm (range, 40–50 mm). Polymethylmethacrylate bone cement used for fixation of the acetabular component included Endurance bone cement (DePuy, Johnson & Johnson, Warsaw, IN, USA) in 19 cases, and Simplex P (Stryker-Howmedica-Osteonics, Mahwah, NJ, USA) in 87 cases. The applied femoral prosthesis included 104 cemented Charnley-type stems made of titanium alloy (H3 taper, 89 cases; PHS type 6, nine cases; PHS type 7, four cases; and H3, two cases; KYOCERA Medical Corporation) and two cementless modular stem (S-ROM; DePuy, Johnson & Johnson). We used a zirconia ceramic modular head in 93 cases (KYOCERA Medical Corporation) and a CoCr modular head in 13 cases (KYOCERA Medical Corporation and DePuy, Johnson & Johnson). The head diameter was 22 mm in 103 cases and 26 mm in three cases.

3. Surgical procedure and rehabilitation program

THA was performed through direct lateral approaches including a Charnley transtrochanteric approach in six cases, Dall direct lateral approach in 89 cases, Hardinge direct lateral approach in six cases, and Wafer approach [8] in five cases. Acetabular bone grafting and acetabular component fixation were performed according to Wolfgang's method [9], which was reported in detail in the previous paper [3]. The grafted bone was fixed with HA-PLLA composite screws (malleolar-type screws, 4.5 mm in major diameter, 3.7 mm in minor diameter) (Fig. 1). We typically used one or two screws according to the size of the grafted bone, and we used three or four screws in high dislocation cases because of the large bony defect in the superolateral corner of the acetabulum. In addition, we used washers of the same composite material in cases in which the grafted bone seemed fragile (Fig. 2). After the screws were applied, the flanged socket was fixed with polymethylmethacrylate bone cement.

Postoperative gait exercise with full weight bearing usually started two days after surgery (early weight bearing group).

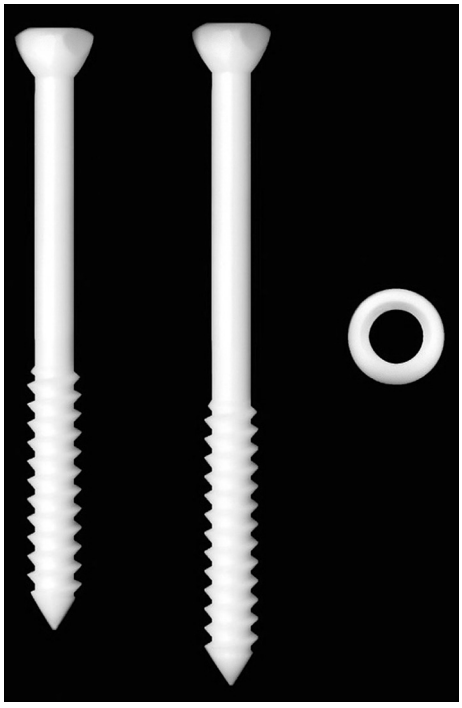

Fig. 1. HA-PLLA composite screws and washers used in this study. From left to right: washer, malleolar-type screws (major diameter: 4.5 mm).

Fig. 2. Grafted bone was fixed with two screws and washers. The arrow indicates the grafted bone, and the arrowheads indicate screw heads and washers. Right side: cephalad; inferior side: posterior.

However, full weight bearing was restricted for 3–8 weeks in 12 cases (late weight bearing group), which included one intraoperative femoral penetration case, and those in which a Charnley transtrochanteric approach was applied or large acetabular bone grafting was performed.