The Constrained Acetabular Component for Hip Instability

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Abstract: One hundred four hips in 107 patients undergoing revision arthroplasty of the hip were identified at risk of dislocation and treated with the constrained cup. Radiostereometric analysis was performed to assess prosthesis migration. Mean follow-up was 3.0 years (range, 2.0-4.8). At last review, 19 patients had died and 6 were lost to follow-up. There were 5 revisions for cup loosening and a further 4 with radiographic evidence of loosening. There were 3 dislocations and 3 dissociations in 5 patients. Radiostereometric analysis demonstrated that cup migration at 24 months was up to 0.82 mm of translation and 1.58° of rotation. Our results confirm that the constrained acetabular component is a highly effective option for the treatment for patients with instability of the hip. The aseptic loosening rate was higher than previously reported. **Key words:** constrained acetabular component, hip instability, revision arthroplasty.

The prevalence of dislocation after primary hip arthroplasty is around 3% [1] and rises to between 5% [1,2] and 20% [3,4] for revision arthroplasty. The financial and functional costs are frequently underestimated [5,6]. Predisposing factors include gluteal deficiency, trochanteric nonunion, soft tissue imbalance, component malposition, impingement, and neuromuscular disorders [7,8].

Numerous surgical techniques have been described to treat hip instability. These include correction of malpositioned prostheses [9,10], use of a liner augmentation wedge [11,12], increasing femoral head size with a jumbo head [13-15] or bipolar hemiarthroplasty [16], removal of impinging tissue [17], and bony or soft tissue reconstruction [18-21]. These techniques have met with limited success [22].

First described for the treatment of tuberculosis of the hip in the 1960s [23], the constrained acetabular component has since been developed to combat instability where other methods have failed. It is designed to hold the head "captive" within the acetabular component by means of a locking mechanism. Forces that would otherwise cause dislocation are transferred to the locking mechanism, the liner-shell, or bone-prosthesis interfaces. The device is simple to use and results in immediate stability, which is reflected in the success reported in several large series [24-27]. Potential disadvantages to the constrained liner include increased interfacial stresses resulting in acetabular loosening, dissociation of the constrained component requiring open reduction, and reduced range of motion [24,28,29].

Although frequently highlighted, the concerns about component loosening have not been thoroughly examined. The aim of this prospective study was to report our clinical and radiographic findings on a series of patients treated with the constrained

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cup for hip instability, with an emphasis on implant loosening using radiostereometric analysis (RSA). We have previously published our results of the constrained cup for recurrent dislocation [30] and now include a cohort of patients with instability at revision arthroplasty.

Materials and Methods

Demographics

Ethical approval for tantalum bead insertion (for RSA) was granted by the local human research ethics committee. The inclusion criteria were recurrent dislocation and instability at revision surgery, where no correctable cause could be identified. One hundred four patients (107 hips) were recruited and treated with a constrained acetabular component. There were 34 hips with recurrent dislocation and 73 with instability at revision surgery. The indications for revision in the latter group were aseptic loosening (56), second-stage revision for infection (8), periprosthetic fracture (8), and conversion from a Girdlestone (1). There were 60 women and 44 men with a mean age of 76.9 years (range, 32-93). Mean height and weight was 1.64 m (range, 1.48-1.77 m) and 70.3 kg (range, 40–125 kg), respectively. Fifty-three procedures were performed on the left hip and 54 on the right. The mean time between primary total hip arthroplasty and index case was 12.2 years (range, 1-33). Average number of dislocations was 4.1 (range, 2-12).

Follow-Up

All patients were reviewed clinically and radiographically by independent observers. Postoperatively, the patients were seen at 6 weeks, 3 months, 6 months, and annually. Patients were scored preoperatively with the Western Ontario and McMaster Osteoarthritis index (WOMAC) score and postoperatively with the WOMAC, Harris hip, and Short Form 36 (physical component) scores. The most recent radiographs of the deceased patients were reviewed.

Radiographic Assessment

Plain radiographs were taken to assess component migration, wear, and loosening. Films were reviewed by 2 independent observers (RJKK and RA) and compared with previous films. Location of radiolucent lines was classified according to Gruen et al [31] and DeLee and Charnley [32]. Loosening of uncemented femoral components was classified according to Engh et al [33] and acetabular components using a modification of the system of Engh, described by Bremner et al [25]. Loosening of cemented components was classified according to Harris et al [34,35]. Heterotopic ossification was classified according to Brooker et al [36]. In addition, we measured cup inclination, acetabular offset, femoral offset, and craniocaudal level of joint (vertical height of hip joint as a proportion of the distance between the transtuberosity line and a parallel line drawn bisecting the greater sciatic notch).

Tantalum beads were inserted into the cup and pelvis at the time of the index procedure (Fig. 1). Patients were followed up with postoperative (baseline), 6-month, and annual radiographs using the standard RSA technique [37]. Migration and rotation of the cup in 3 planes was recorded by 2 independent observers. Accuracy of the nonzero movement of the RSA technique was tested on pairs of radiographs taken on the same occasion but separated in time by 5 minutes. Any implant movement between the radiographs was an error of nonzero movement.

Operative Data

All procedures were performed or directly supervised by 1 of 2 surgeons (BN and DW). Procedures

Fig. 1. AP Radiograph of a well fixed constrained cup used for instability secondary to bony and soft tissue deficiency following multiple surgery. Note the Tantalum beads embedded into the pelvis.