Long-term results of the threaded Weill cup in primary total hip arthroplasty

A 15–20-year follow-up study

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Abstract Uncemented, threaded acetabular components with smooth surface treatment were widely used in continental Europe in the 1970s and 1980s for primary total hip arthroplasty (THA). Previously published studies showed high failure rates in the mid-term. In a consecutive series of 116 patients, 127 threaded cups with smooth surface treatment (Weill cup; Zimmer, Winterthur, Switzerland) were implanted in combination with one type of uncemented stem. Patients were followed up clinically and radiographically. Mean time of follow-up was 17 years (range 15–20). At the time of follow-up, the acetabular component had been revised or was awaiting revision in 30 hips (24%). Two hips were revised for infection and 23 for aseptic loosening. Four polyethylene liners were exchanged because of excessive wear. One hip was awaiting revision. The survival rate for all acetabular revisions including one hip awaiting revision was 75% (95%CI: 65–85%) at 17 years. These results support the view that smooth, threaded acetabular components do not provide satisfactory long-term fixation and should be abandoned. It is important to closely monitor patients with these components as the failure rate remains high in the long-term.

Introduction

In the 1970s and 1980s, uncemented, threaded acetabular components with smooth surface treatment were widely used in continental Europe for arthroplasty of the hip to

overcome the high rate of aseptic loosening in cemented hip arthroplasty in young patients. Various designs of threaded uncemented cups have been introduced, achieving initial stability by interference of the threads with acetabular bone. A high primary stability which is a prerequisite factor for bone ongrowth and long-term fixation has been described for threaded acetabular components [13, 20, 22]. The surface treatment of these implants was smooth in most cases. Threaded designs lead to rigid primary fixation, but long-term secondary fixation with bone ingrowth is unlikely to occur and consequently high rates of mid-term loosening and failure were reported in the short- and medium-term [6, 14, 34]. Only a few long-term results of threaded cups have been reported in the literature with a great variability in survival [9, 17, 21, 23, 37]. Surface treatment seems to have a major effect on the incidence of radiographic loosening and survival [10]. Although inferior results with a high rate of catastrophic failures for Weill acetabular components (Zimmer, Winterthur, Switzerland) have already been reported [4, 14, 34], it is important to monitor patients regularly in the long-term, as a high rate of painless migration has been described [1, 4]. The aim of our study was to determine the long-term (>15 years) outcome in a patient cohort treated with a smooth threaded cups. We evaluated the clinical and radiographic outcome of a multi-surgeon series of 116 consecutive patients treated with a Weill acetabular component.

Material and methods

Implants

In this study, one type of uncemented, threaded, screw-in component with smooth surface treatment was investigated

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(Weill cup; Zimmer, Winterthur, Switzerland). This component has a central opening which enables visualisation of the contact between implant and bone. Weill cups consist of a smooth, threaded, conical ring made of pure titanium (Fig. 1) and a PE liner. For acetabular reaming a conical reamer is used, and threads are precut by a thread-cutting device. The posterior opening is closed by the PE liner. In all cases, 32-mm ceramic heads (BioloX, Ceramtec, Plochingen, Germany) were used. The acetabular component was implanted in combination with one type of uncemented, straight, collarless component in all patients. It was made from Ti6Al7Nb alloy (Protasul 64) with a micro-porous surface treatment ($Ra=4.4\text{ }\mu\text{m}$) according to ISO 5832-11 (CLS; Zimmer, Winterthur, Switzerland). It had a wedge-shaped taper in all three planes with proximally, anteriorly and posteriorly-located ribs/flutes.

Patients

This study comprised a consecutive series of 116 patients with 127 hips implanted between January 1985 and December 1989. Patient demographics and preoperative diagnoses are given in Table 1. The operative technique and postoperative protocol have been previously described [4].

Evaluation protocol

At follow-up, a standardised questionnaire, including the items of the Harris hip score, was obtained for each hip [18]. Clinical assessment included limp, range of motion and pain. Patients assessed their pain in the operated hip at the time of follow-up on a visual analogue scale (0–10). Radiographs were examined independently by two experienced orthopaedic surgeons for cup migration, radiolucent lines, osteolysis and acetabular loosening.

Acetabular loosening was defined as continuous migration >5 mm, tilting of >5° or bone resorption >5 mm compared

Fig. 1 Smooth threaded Weill acetabular cup (Zimmer, Winterthur, Switzerland)

Table 1 Preoperative diagnoses and demographics of patients included in the study

Parameter	Value
Demographics (years)	
Age	57 (13–81)
BMI	27 (23–32)
Follow-up	17 (15–20)
Distribution, <i>n</i> (%)	
Hips	127
Male	70 (55)
Female	57 (45)
Left	66 (52)
Right	61 (48)
Diagnoses, <i>n</i> (%)	
OA	65 (56)
DDH	22 (19)
AVN	16 (14)
Posttraumatic	8 (7)
RA	2 (2)
Others	2 (2)

BMI body mass index, *OA* osteoarthritis, *DDH* developmental dysplasia of the hip, *AVN* avascular necrosis, *RA* rheumatoid arthritis

with baseline radiographs. The threshold for loosening of the acetabular component was chosen to be 5 mm because of potential inaccuracy of simple measurements on plain radiographs. Radiolucent lines were determined according to DeLee and Charnley [11]. Osteolysis was determined as regional progressive bone changes on serial radiographs.

Statistics

Kaplan-Meier survival analyses were calculated using revision for aseptic loosening and revision of the cup for any reason, including patients awaiting revision as endpoint to plot the cumulative survival rate [27].

Results

Sample

During the follow-up period, 35 patients (38 hips) died, and five patients (5 hips) were lost. Follow-up data were obtained for 54 hips. Radiological data were obtained for 36 hips. Clinical data but no radiographs were obtained for 18 hips (Fig. 2). The 15–20-year follow-up rate was 66% for the entire patient group and 94% of patients were still alive at the time of follow-up.

Fig. 2 Distribution of hips with Weill cup at a minimum follow-up of 15 years

Deceased patients

Thirty-five patients with 38 hips had died before the most recent follow-up (Fig. 2). The mean age of these patients at the time of the operation was 61 years (range 41–81), and the mean duration of follow-up was nine years (range 0–17).

Revisions

In 92 hips (72%), the acetabular component had not been revised. In 30 hips (24%), the cup had been revised or was awaiting revision. Two hips were revised for deep infection. A total of 23 acetabular implants were revised for aseptic loosening. Four polyethylene inserts were exchanged. One hip was awaiting revision (Fig. 2).

Radiographic evaluation

For radiographic analysis of the acetabular component, 36 unrevised hips were available for follow-up. Two cups (6%) had continuously migrated. Radiolucent lines (>2 mm) were found in zones 1–3 according to Charnley and DeLee in nine hips (25%). For the femoral component, radiographic loosening was not observed in any case, and there was no distal cortical hypertrophy or femoral osteolysis. Stress shielding with atrophy of the proximal femoral region was not detected [1–3].

Clinical evaluation

The mean Harris hip scores [18], mean Merle d'Aubigné scores [24] and pain levels on a visual analogue scale were assessed. Charnley class [7] was determined to demonstrate potential effects of bilateral hip disease or comorbidity on

the Harris hip score (Table 2). Most patients with acetabular migration had only mild or moderate pain. The Harris hip score was highly dependent on the Charnley class (Table 2). No significant difference in the clinical scores was found in

Table 2 Clinical results at follow-up including HHS (Harris hip score), Merle d'Aubigné score and pain on visual analogue scale (VAS)

Harris hip score	Mean (range)	
All hips	79 (23–100)	
Stable cup	80 (27–99)	
Revised cup	79 (34–98)	
Charnley	HHS (mean)	Merle (mean)
A	86	4
B	82	3
C	73	2
Harris hip score	n (%)	
Very good (91–100)	18 (33%)	
Good (81–90)	15 (28%)	
Satisfactory (71–80)	10 (19%)	
Moderate (50–70)	5 (9%)	
Poor (0–49)	6 (11%)	
Pain (VAS)	n (%)	
No pain (VAS 0)	44 (70%)	
Slight pain (VAS 1–3)	10 (16%)	
Mild pain (VAS 4–6)	5 (8%)	
Moderate pain (VAS 7–9)	3 (5%)	
Severe pain (VAS 10)	1 (1%)	

stable cups, cups with radiolucency and revised cups. No leg length discrepancies were found in 74% ($n=26$) of patients with clinical follow-up. In 14% ($n=5$) a leg length difference of 0.5–1.5 cm was found, in 6% ($n=2$) a difference of 1.5–2.5 cm and in 6% ($n=2$) a difference of >2.5 cm was measured, which was a result of gross loosening of the cup in most cases.

Survivorship analysis

In Kaplan-Meier analysis, failures occurred steadily for up to ten years, when a marked increase in failure rates was noted (Fig. 3). The survival rate for all revisions including one hip awaiting revision was 75% (95%CI: 65–85%) at 17 years. Survival with acetabular revision for aseptic loosening as an endpoint was 78% (95%CI: 67–88%) at 17 years. The Kaplan-Meier analysis of the stem showed a low annual failure rate and a survival rate of 90% for femoral components at 17 years (95%CI: 83%–94%) with revision for any reason as endpoint. Survival with femoral revision for aseptic loosening as an endpoint was 94% (95%CI: 87%–97%) after 17 years. The survival rate for the stem remained unchanged until year 20 as no more revisions occurred in this period [1, 2].

Discussion

Aseptic loosening of the acetabular component over time especially in young patients remains one of the major problems after THA [15]. Some uncemented acetabular components rely on biological fixation and have achieved

lower rates of aseptic loosening at ten years compared with cemented acetabular components in younger patients [5, 8, 12, 35]. However, revision rates for uncemented cups are higher because of accelerated polyethylene wear and osteolysis [19, 35].

In the past, two main factors for long-term survival of uncemented implants have been identified: (1) primary stability with stable bone-implant interlock and minimal micro-motion and (2) secondary osteointegration for long-term stability. Threaded cups have been reported to achieve high primary stability and the concept of threaded cups has gained wide acceptance. However, an adequate surface finish, most commonly achieved by porous coating, hydroxyapatite coating or grit-blasted titanium, is considered essential for secondary bone on- or ingrowth of the implant [26]. Recently, long-term studies of uncemented grit-blasted threaded components have been published, proving long-term survival equal to the rates of hemispherical press-fit cups [16, 28, 31–33, 36, 38, 39].

In our study only threaded acetabular components with a smooth surface treatment were used. The survival was considerably lower compared to contemporary designs with rough surface treatment [16, 28, 31–33, 36, 38, 39]. We discontinued the use of smooth threaded components in 1993.

The most likely cause of the reported high failure rates was an insufficient biological fixation due to the smooth surface treatment and a lack of secondary osteointegration [10, 29].

The central opening of the cups allows direct contact between the polyethylene liner and the surrounding bone. Micromovement caused by loading and unloading has been

Fig. 3 Kaplan-Meier survivorship curve for all revisions including hips awaiting revision as the endpoint. The 17-year survival rate was 75% (95%CI: 65–85%)

Fig. 4 Postoperative radiograph after implantation of the Weill cup (Zimmer, Winterthur, Switzerland) in a 52-year-old man with primary osteoarthritis (left). Acetabular loosening with fixation failure and massive bone loss ten years postoperatively (right). The patient only noticed leg length discrepancy

shown to occur between the threaded cup and the acetabulum [30]. This may result in the production of debris from the polyethylene inlay giving rise to a foreign-body-induced osteolysis at the bone implant interface promoting aseptic loosening.

Surprisingly, aseptic loosening and migration did not lead to pain and impairment in many cases. A considerable number of patients even with severe bone loss reported only slight pain and noticed leg length discrepancy. This scenario is particularly worrisome and, therefore, with this type of acetabular component, regular radiographic follow-up seems advisable to detect painless migration before severe bone loss can occur, thus necessitating more demanding revision surgery (Fig. 4).

To date, there are no published long-term results for smooth hemispherical threaded cups. Our results show that in the tenth postoperative year revision rates rise, and consecutive annual radiographic follow-up is mandatory to prevent bone loss due to osteolysis and migration [25]. We conclude that smooth threaded sockets do not provide satisfactory long-term outcome and should be abandoned. The rate of aseptic loosening and progressive bone loss remains high even 15–20 years after the initial surgery.

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