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ORIGINAL PAPER

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Revision cup arthroplasty using Burch-Schneider anti-protrusio cage

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Abstract From 1986 until 1995 we used the Burch-Schneider anti-protrusio cage in 31 patients (33 hips) and followed the patients for 5 years. Five patients died within the 5-year follow-up. Clinical outcome listed an average Harris hip score of 71/70/66 points after 1, 2 and 5 years respectively. One patient had a revision due to late-onset haematogenous infection. We found cup migration in nine patients. Migration was self-limiting in three cases and in two there was no bony graft ingrowth. Screw breakage was seen in one case. All migrated cages showed a higher rotational centre than cages without migration.

Résumé Entre 1986 et 1995 nous avons utilisé l'anneau anti-protrusion de Burch Schneider chez 31 malades (33 hanches) qui ont été suivis 5 années. Cinq malades sont morts dans ce délai. Le résultat clinique donne un score moyen de Harris de 71/70/66 points après respectivement 1, 2 et 5 années. Un malade a eu une révision à cause d'une infection hématogène à début tardif. Nous avons trouvé une migration de la cupule chez 9 malades. La migration s'était limitée spontanément dans trois cas. Dans deux cas il n'y avait aucune réhabitation de la greffe. Une rupture de la vis a été vue dans un cas. Toutes les cupules ayant migré avaient un centre rotationnel plus haut situé que les cupules sans migration.

Introduction

In 1974 Burch initiated the construction of a custom-made acetabular implant to bridge a large posterior acetabular wall defect following a pelvic fracture. This implant remained in use for more than 25 years. In 1976 Schneider embraced the idea and the Burch-Schneider anti-protrusio cage (BS) was established. The original implant was manufactured from polished steel. From 1988 the BS was made of smooth-blasted titanium and from 1998 of rough-blasted titanium.

We have used the BS when serious deficiencies or weakening of the acetabular bone stock were present. The aim of this study was to evaluate the clinical and radiological outcome of its use.

All data originated from Kantonsspital Liestal, Switzerland

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Materials and methods

From January 1986 until September 1995 we implanted the BS in 31 patients (33 hips). One patient had bilateral implantation and one had a second cage after revision. Four cages were made of steel and 29 of smooth-blasted titanium. Mean patient age at the time of operation was 75 (42–90) years. The male/female ratio was 1:1.1. In 21 cases the operation was the first operative revision, in nine the second and in three the third. In four cases the revision was performed due to an infected prosthesis. During surgery the acetabular defects were classified according to Paprosky [16] and the American Academy of Orthopedic Surgeons (AAOS) [4] (Table 1).

Operative technique

Using pre-operative planning the intent was to restore the centre of rotation to its original site. In cases where the defect was extensive repositioning may have been restricted to a point between the original centre of rotation and the centre of the iliosacral joint (Fig. 1).

Bony cavities in the weight-bearing area were filled with autologous grafts. Deep-frozen allografts were used in non-weight-bearing areas and in very old patients. To achieve additional primary stability a cement pillar was sometimes added in craniomedial direction.

Necessary bending of the proximal and distal flanges was estimated using a trial cage (Fig. 2), and the centre of rotation was situated at the preferred place (Figs. 1 and 3). The distal flange of the BS was driven into the ischial bone, and the proximal flange was screwed to the side wall of the iliac bone (Fig. 3). Screws directed dorsally and distally prevented a shift in the craniolateral direction. Additional screw(s) placed from inside the cage concavity

Table 1

Number	Female/ male	Left/right	Age at operation	Follow-up (yr)	No. of revisions	Defects		Harris hip score post-op.			Migration 5 yr	Migration (mm) 5 yr	Radiolucency 5 yr	Late complications
						AAOS	Paprosky	1 yr	2 yr	5 yr				
1	F	R	69	13	1	III	3a	78	78	68	No		No	
2	M	L	68	4[b]	2	II	2a	82			–[e]	–[e]	–[e]	
3	F	R	73	10	3	I	3a	61	61	60	Cranial	3.1	No	
4	M	L	74	12	2	III	3b	80	71	48	Medial	4.2	No	
5	F	R	78	12	1	III	3b	72	54	27	Craniomedial	11.9	Medial	Late infection
6 (Patient 5)	F	R	83	7	2	IV	3b[c]	61	48	43	No		No	
7	F	L	67	11	1	III	3a	71	57	68	Craniomedial	4.2	No	
8	F	L	87	1[b]	1	III	2c	72			–[e]	–[e]	–[e]	
9	M	L	78	8	2	III	3a	42	32	30	–[e]	–[e]	–[e]	
10	F	R	83	4[a]	1	III	3b	82	79	71	–[e]	–[e]	–[e]	
11	F	R	72	4[a]	1	II	1[c]	54	57	57	–[e]	–[e]	–[e]	Luxation
12	F	L	74	7	1	I	2b	84	82	74	No		No	
13	F	L	77	7	3	III	2c[c]	53	56	47	Lateral	2.9	Surrounding	
14	F	L	64	7	2	III	2b	70	82	78	No		No	
15	F	L	83	7	1	III	2b	71	88	65	No		No	
16	M	R	81	1[b]	1	III	2c				–[e]	–[e]	–[e]	
17	M	R	77	7	1	III	3a	63	74	76	No		No	
18	M	R	77	7	1	III	2c	65	62	69	No		No	
19	M	L	84	5	1	II	2a	82	85	66	No		Cranial	
20	F	R	68	6	2	III	2c	62	79	77	No		Medial	
21	M	R	85	6	1	III	3a	73	73	74	Lateral	2.3	No	
22 (Patient 21)	M	L	85	6	1	III	2b	60	59	60	No		No	
23	M	R	69	2[b]	1	III	2b	71	61		–[e]	–[e]	–[e]	
24	M	L	53	6	2	II	2a	71	74	68	No		No	
25	F	R	73	6	1	III	2a	89	88	89	Cranial	2.1	Cranial	
26	F	R	59	6	2	III	2b	79	85	88	No		No	
27	M	R	79	6	1	III	2b	80	69	69	No		Cranial	
28	F	R	74	4[a]	1	III	2b	86	85	76	–[e]	–[e]	–[e]	
29	M	R	90	1[b]	1	III	3a				–[e]	–[e]	–[e]	
30	M	L	42	5	1	I	3a	79	85	66	Craniolateral	3.1	Surrounding[d]	
31	M	L	81	5	2	IV	3b	76	75	60	Craniomedial	5.4	No	
32	M	R	81	5	3	III	3a[c]	60	50	76	No		Cranial	
33	F	L	82	5	1	III	3a	85	85	85	No		No	

[a] Refused control but returned questionaire, [b] died, [c] no full range of radiographs, [d] broken screws, [e] not measurable/no X-rays

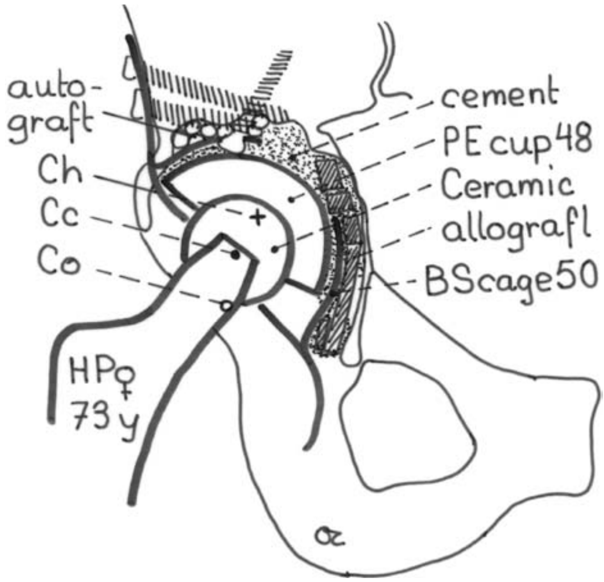

Fig. 1 Pre-operative planning. The cage is moulded to the remaining bone, impacted distally, and fixed with screws cranially. The cavity is filled cranially with autograft protected from the cement by a re-absorbable net, and medially with an allograft

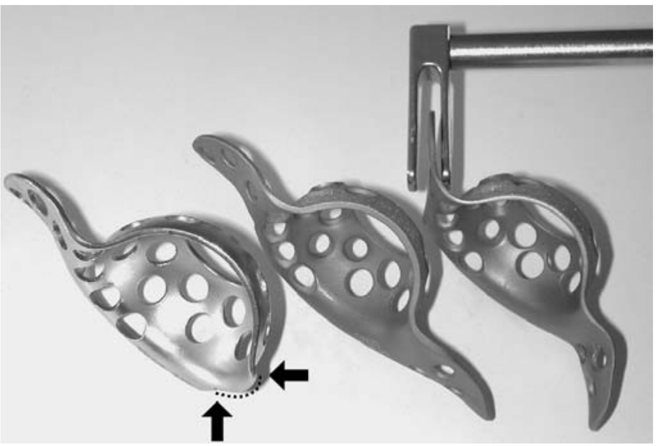

Fig. 2 Trial cage and anti-protrusio cage. The trial cage is without a distal flange (*arrows*). The anti-protrusion cage is moulded with bending instruments to the adequate shape determined by the trial cage

and directed towards the iliosacral joint gave angular stability. Finally, the cup – in its correct orientation – was cemented into the cage (Fig. 3b).

Prospective clinical and radiological follow-up data (pre-operative, and after 1, 2 and 5 years) were registered on Maurice Müller Foundation forms [12], from which the Harris hip score was derived [10]. The Merle d'Aubigné score was registered as well [14]. During each follow-up visit standardised pelvic radiographs were performed to allow for cup migration measurements. For radiolucency we considered the presence of a radiolucent line of 2 mm in a quadrant of the acetabulum, denominated as medially, medio-cranially, cranially or surrounding [5]. The position of the centre of rotation compared to the anatomical centre was measured. Attention was given to the remodelling of bone grafts placed behind the concavity of the cage (Fig. 3c and d).

We used the Ein Bild Röentgen Analyse (EBRA) method to measure cup migration [13]. Cage migration was measured on digitised anteroposterior pelvic radiographs with an accuracy limit of 1 mm in the medial-lateral as well as the craniocaudal direction. Migration analysis using the EBRA method included the extent, direction and time-dependance of progression.

Results

Of 31 patients, five died before the 5-year follow-up examination. Three refused radiological control but sent back a questionnaire. This left 31 hips after 1 year, 29 after 2 years and 28 after 5 years. Full radiological follow-up was present in 24 hips.

As late complications (Table 1) we observed one haematogenous infection 2 years after operation. This was successfully revised with a two-stage procedure [15]. We observed six general complications. None of the complications led to permanent impairment or death.

Pre-operatively 32/33 hips were registered with unbearable to severe pain. One year after operation 30/31 had slight or no pain. Also 1 year after operation moderate or severe limping was present in 12/31 and in 13/28 after 5 years. Satisfaction (very good and good) was found in 28/31 patients after 1 year and in 26/28 after 5 years. The Harris hip score was 71/70/66 points after 1, 2 and 5 years respectively (Table 1). The Merle d'Aubigné pain score shifted from 2.5 points pre-operatively to 5.5 after 1 year and 5.2 after 5 years. We found no significant relation between clinical results and size of defects.

Radiographically, out of 24 cases, a full radiolucent line was observed in two and a partial in six. Both implants with full radiolucency showed migration. In two cases we observed that radiolucency diminished up to the second year.

In two cases re-organisation of the bony trabecular structure failed to appear in the weight-bearing area of the acetabulum after 2 years. One patient died before the 5-year follow-up, and one showed bony re-organisation after more than 2 years.

EBRA measurements of cup migration after 5 years were possible in 24 cases. Fifteen cases showed no measurable migration while migration was found in nine. In one case sudden onset of migration 2 years after implantation indicated infection. In eight cases migration measured an average of 3 (2.2–4.2) mm. In three cases it was self-limiting after 1 year while in five it continued up to the 5-year control. Migration was seen in four out of six cases without screws, originating from the concavity of the cage. There was no relation between the size of acetabular defect and migration.

The height of the centre of rotation was determined. Cages with high rotational centres showed greater migration than those placed relatively lower. If the centre of rotation was placed lateral to the anatomic centre, no increase in radiolucency or migration was found. In one case screw breakage was seen. There was also surrounding radiolucency and migration, and the implant was regarded as loose. Because of minimal pain revision was declined.

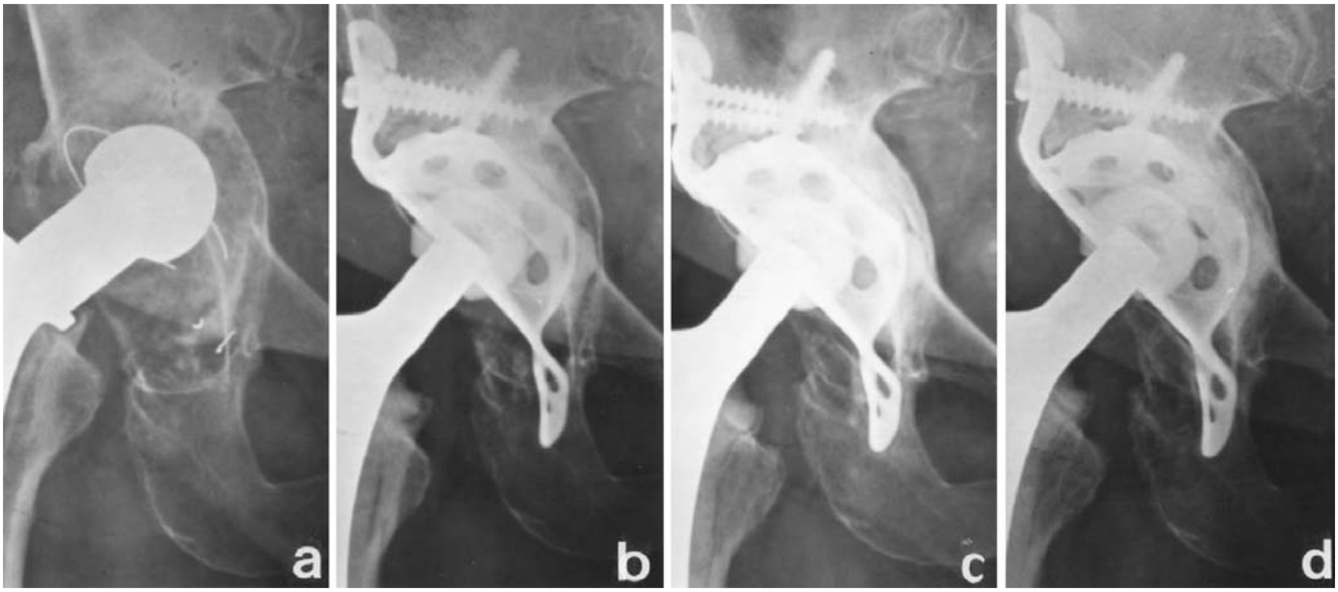

Fig. 3 Five-year follow-up of a 73-year-old woman. **a** Loosening of the cup and stem 12 years after primary hip replacement; **b** moulded cage, distally impacted in the ischial bone, proximally fixed with two horizontal screws through the flange and one out of the cage, together with a cement pillar; **c** 1-year follow-up; **d** 5-year follow-up. No loosening or wear, no pain, no limp, walking time 1 h

Discussion

Reconstruction of acetabular defects using bone cement, massive allografts [3, 11, 18] or large bipolar femoral components seems to be of limited value [6]. Impaction grafting is still a debated technique [22]. The advantage of the BS is a stable bridging of the defect thereby achieving primary stability. Using anchorage in the ischial and iliac bones, the cage makes bony reconstruction possible.

The centre of rotation is restored to the anatomical place or (in large defects) a place on the line between the anatomic centre and the centre of the iliosacral joint [21]. Therefore, the cage has to be moulded (Fig. 2) and the distal flange impacted in the ischial bone (Figs. 1 and 3). In comparison to earlier techniques, the trial cage facilitates bending and impaction in the ischial bone [1]. A craniomedial cement pillar between the cage and the acetabular cavity (Fig. 1), and horizontal screws fixing the proximal flange to the iliac bone (Fig. 3), give primary stability and make early weight bearing possible, thus stimulating integration of the grafts.

Compared to other studies [7, 8, 9, 17, 20, 21] we had nearly twice as many women, and our patient population was almost 10 years older. Recent papers [24, 25, 26] have, however, patient groups comparable to ours. Using the AAOS classification [4] we found 64% type III defects, which in the literature ranges from 22% [8] to 100% [1]. Using Paprosky's classification [16] we found 46% type IIIa/b defects compared to only 36% found by Böhm [2].

The complication rate was comparable to other studies [1, 2, 8, 26]. There was no early and only one late infection. Radiolucency around the cage was encountered in one third of cases, a figure comparable to other studies [1, 21], although Wachtl found only 13% [25]. Until now no revision has been necessary due to aseptic loosening, which indicates a low revision rate [1, 8, 9, 17, 20]. Only two studies [2, 26] mention a single revision of the BS.

Patients with major defects showed the same degree of satisfaction as patients with smaller defects. Using Merle d'Aubigné and Harris scores our findings were in accordance with other studies [1, 23, 24]. In our series limping was a prominent feature. Possai [19] suggested this to be caused by the extended exposition of the gluteal medius muscle. Despite the metal cage migration, analysis with the EBRA method was useful. Out of nine cages with migration eight showed a mean migration of only 3 mm. Keeping in mind the advanced age of the patients and the generally large defects, the clinical outcome was satisfying.

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