M. Salaman Ali · A. Kumar

Isoelastic femoral component in primary cementless total hip arthroplasty

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Abstract We followed 100 patients (111 hips) who underwent primary total hip arthroplasty between July 1988 and June 1995 using the isoelastic femoral component. The average age was 61 (30–70) years. Mean follow-up time was 8.4 (5–12) years. Three femoral components were revised for aseptic loosening and one for disabling thigh pain. Six additional femoral components were considered probably loose by the radiographic criteria. Osteolysis around the femoral component was noted in only two patients who were clinically asymptomatic. A high incidence (41%) of lateral migration of the tip of the femoral components was noted, but there was no significant distal migration. Nine patients complained of thigh pain, which interfered with their daily activities. The average Harris hip score improved from 49 to 80 at the latest follow-up. We believe that the principle of isoelasticity in hip replacement is important; however, improvements in the material and the design of the femoral component are required.

Résumé Nous avons suivi 100 malades (111 hanches) après une arthroplastie totale utilisant un composant fémoral isoélastique entre juillet 1988 et juin 1995. L'âge moyen était 61 (30–70) années. La moyenne de suivi était 8.4 (5–12) années. Trois composants fémoraux ont été révisés pour descelllement aseptique et un pour douleur invalidante de la cuisse. Six composants fémoraux ont été considérés probablement descellés sur les critères radiographiques. Une ostéolyse autour du composant fémoral a été notée chez deux malades seulement et elle était asymptomatique. Une haute fréquence (41%) de migration latérale de la pointe des composants fémoraux a été notée mais il n'y avait aucune migration distale. Neuf malades se sont plaints de douleur de la cuisse qui a perturbé leurs activités journalières. Le Score moyen de Harris a été amélioré de 49 à 80 au dernier recul. Nous croyons que le

principe isoélastique dans la prothèse de la hanche est intéressant, cependant des améliorations dans le matériau et le dessin du composant fémoral sont nécessaires.

Introduction

The concept of isoelasticity in joint replacement was introduced by Roger Mathys and popularised by Bombelli [5]. We are presenting our experience of using isoelastic femoral component in a comparatively younger and more active population.

Patients and methods

Between July 1988 and June 1995, 113 patients (127 hips) underwent primary total hip arthroplasty using the hydroxyapatite (HA) coated RM cup (Robert Mathys, Switzerland) and isoelastic femoral component [5]. We used a 32 mm snap fit stainless steel head in the first 22 hips (Fig. 1) and thereafter a 28 mm zirconium head (Fig. 2). Four patients were lost to follow-up, and nine died due to unrelated causes during the course of this study. Finally, 100 patients (111 hips) were reviewed; 51 men and 49 women. Eleven patients had bilateral hip replacement. Forty-five replacements were on the right side and 44 on the left. The mean age of patients at the time of operation was 61 (30–70) years. The mean follow-up time was 8.4 (5–12) years.

Preoperative diagnosis was osteoarthritis in 97 hips, rheumatoid arthritis in five, avascular necrosis in six, and Perthe's disease in three. A direct lateral approach was used in all hips. All patients received three doses of intravenous antibiotic and thromboembolic prophylaxis. In the postoperative period patients were rapidly mobilised, allowing weightbearing with crutches for 6 weeks. Walking aids were discarded soon after this period. All patients were regularly followed clinically—after discharge at 6 weeks, again at 6 months, and thereafter yearly—with a questionnaire and radiographs. The functional assessment was done using Harris hip score [11] and the six-digit scale of Merle d'Aubigne and Postel [20] as modified by Charnley [9].

Radiologically, the femoral component was assessed in seven zones as described by Gruen et al. [10]. Osteolysis was defined as a newly developing expansile cystic lesion, with endosteal scalloping not present in the immediate postoperative radiograph, and showing progression in subsequent radiographs. Subsidence of the femoral component was measured by comparing the vertical distance between the collar of the implant to the lesser trochanter in the immediate postoperative radiograph, and then each follow-up radio-

M.S. Ali (✉) · A. Kumar
Department of Orthopaedic Surgery, Corbett Hospital,
Stourbridge, West Midlands, DY8 4JB, UK
e-mail: M.Ali@dudleygoh-tr.wmids.NHS.uk
Tel.: +44-1384-244674, Fax: +44-1384-244693

Fig. 1 **a** One-year postoperative radiograph of the isoelastic femoral component with stainless steel head. **b** Radiograph at 12-year follow-up showing an excellent position of prosthesis with no evidence of loosening

Fig. 2 Bilateral total hip replacement using isoelastic femoral prosthesis with ceramic head. Right side at 8-year and left side at 7-year follow-up

graph. Definite loosening was indicated if there had been a subsidence of more than 5 mm or in the presence of a continuous radiolucent line around the stem. If a radiolucent zone was present that surrounded 50% or more of the stem (three zones), the component was considered as probably loose [25]. Heterotopic ossification was graded according to the classification of Brooker et al. [6].

Results

Clinical evaluation

The average Harris hip score improved from preoperative score of less than 50 to 80 after a mean follow-up of 8.4 years. The average Charnley score for pain and walking were 5.2 and 5.0, respectively. Thirty-five patients complained of thigh pain of varying degree. Significant thigh pain, which limited daily live activities, was seen in only nine patients.

Both intraoperative and postoperative complications were recorded (Table 1). Four femoral components were revised. Three revisions were for aseptic loosening after 3, 4, and 7 years. One component was revised after 8 years for disabling thigh pain.

Overall there were 64 excellent or good, 15 fair, and 28 poor results. In Charnley class A 75% of results were excellent or good, whereas in class B and C, 71% and 30%, respectively, were either excellent or good (Table 2).

Radiological evaluation

Of 107 femoral components still in place, six components were considered probably loose and none definitely loose by the radiological criteria of Sochart and Hardinge [25]. The tip of the femoral component migrated laterally in 44 hips (Fig. 3). This migration was less than 5 mm, and was not progressive in any case. There-

Fig. 3 **a** Early postoperative radiograph. **b** Radiograph at 8-year follow-up showing lateral migration of the tip of the prosthesis but without any evidence of loosening in any zone. Patient is completely asymptomatic

Table 1 Complications

Complications			
Local			
Infection	Superficial		1
	Deep		0
Dislocation			0
Foot drop (temporary)			1
Fracture	Shaft		1
	Calcar		2
	Trochanter		6
			4
Revisions			
General			
DVT			5
PE (nonfatal)			3
Chest infection			1
Cardiovascular			1
Urinary tract infection			1

Table 2 Distribution of Harris hip score according to the Charnley class

Harris hip score	Charnley class A n=33	Charnley class B n=38	Charnley class C n=40
91–100	17	8	3
81–90	8	19	9
71–80	2	5	8
<70	3	6	19
Revised	3	0	1

fore, these prostheses were not considered definitely loose by radiological criteria. In the entire series cortical osteolysis around the femoral component was seen in only two patients. The trochantric screws were found broken in nine cases, but no local complications like loosening or osteolysis was seen around the screw. Significant heterotopic ossification was seen in ten hips – eight were grade III and two were grade IV.

Discussion

Aseptic loosening is the most common cause of failure of a total hip replacement. This problem has been addressed by improvement in cementing techniques, design of the prosthesis, and development of cementless implants. An ideal cementless implant should be able to achieve proximal stress transfer and provide primary stability to allow bone ingrowth. Studies have shown that flexible stems produce more uniform and normal strain distribution in bone. Loss of bone mass is also less marked with the flexible isoelastic implants than with stiff metal stems [1, 17]. Good short-term results have been reported after using the isoelastic endoprosthesis [3]; however, midterm results have not been satisfactory in other studies [22]. Our results with a revision rate of 3.6% at an average follow-up 8.4 years are certainly better than previously reported studies in this relatively

younger and more active population. An average Harris hip score of 80 was considered satisfactory, taking into account the fact that it included 36 class C patients.

Localised osteolysis has been described around both cemented and uncemented implants. An incidence of 6–24% of osteolysis has been reported around cemented femoral components after using modern techniques [8, 15, 21, 23]. Various particulate materials, including polyethylene debris, cement, and metal, have been implicated as a cause in absence of infection [2, 4, 16, 19, 21]. In our series only two patients were found to have osteolysis around the femoral component. Thigh pain after a cementless total hip arthroplasty has always been a matter of discussion. An incidence of thigh pain from 1 to 50% has been reported after total hip replacement [7, 12, 13, 14]. In our series none of the patients had disabling thigh pain, and only nine patients had thigh pain that limited their routine activities.

A high incidence of lateral migration of the tip of the femoral component was noted in our series. The lateral migration was usually seen on follow-up at 1 or 2 years, and if prosthesis had not migrated in the first 3 years, it did not migrate in subsequent years. Uncemented prosthesis depends on remodelling of the bone around the implant to provide an area for load transfer. Experimental studies have shown that a cementless prosthesis can become loose with posteriorly directed load. In such cases it is recommended that stems should be protected from rotational loading until bone ingrowth has occurred [24], which is not possible in the clinical setting. The cement provides a good fit between bone and prosthesis; however, an early migration can still occur. This is probably caused by resorption of bone by the surgical trauma or by thermal necrosis during polymerisation of the cement [14]. A high incidence of lateral migration in our series could be due to the use of straight reamers, bone resorption due to surgical trauma, poor bone ingrowth into polyacetal resin, and early partial weight bearing.

The isoelastic prosthesis gave satisfactory results in the medium term, especially as these were younger and more active patients. However, we have concerns over the long-term survival of the prosthesis because of lack of bonding resulting in micromotion between the prosthesis and bone. The manufacturers therefore have now developed an isoelastic femoral prosthesis that has titanium porous coating, which would allow better bone ingrowth and at the same time maintain the isoelasticity. We believe that proximal stability and bone ingrowth with isoelasticity are the future of hip implants.

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