Cementless total hip arthroplasty in post-traumatic avascular necrosis of the femoral head in young adults

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Background

Total hip arthroplasty (THA) remains the only effective solution in advanced stages of avascular necrosis (AVN); however, in the long run, this intervention in younger individuals is associated with higher failure rates when compared with the same performed in an older population. Our prospective study evaluates the effectiveness of THA in a young group of patients with post-traumatic AVN.

Patients and methods

Twenty-four patients (19 male, five female) with a mean age of 38 years (range 33–45 years) who had traumatic AVN of the femoral head were operated upon between January 2004 and May 2009. Unilateral cementless THA was performed for all patients. The indications for surgery were severe pain and loss of function in the hip. Plain radiography was used for diagnosis in all cases, and a computed tomography scan was needed in cases of acetabular fractures. In 12 patients, AVN occurred after an internal fixation of acetabular fractures: proximal femoral fracture in eight patients and hip dislocation in four patients.

Results

The mean Harris hip score improved from 40 (preoperatively) to 80 (3 years postoperatively). Six patients had an excellent score, 14 had a good score, three had a fair score, and one patient had a poor score. Improvements were seen in the range of motion in all the patients when compared with the preoperative period.

Conclusion

The management of post-traumatic AVN of the femoral head in young and active patients continues to be a challenge. The results of cementless hip arthroplasties are satisfactory and encouraging in treating this group of patients.

Keywords:
adult, arthroplasty, avascular necrosis, cementless

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Introduction

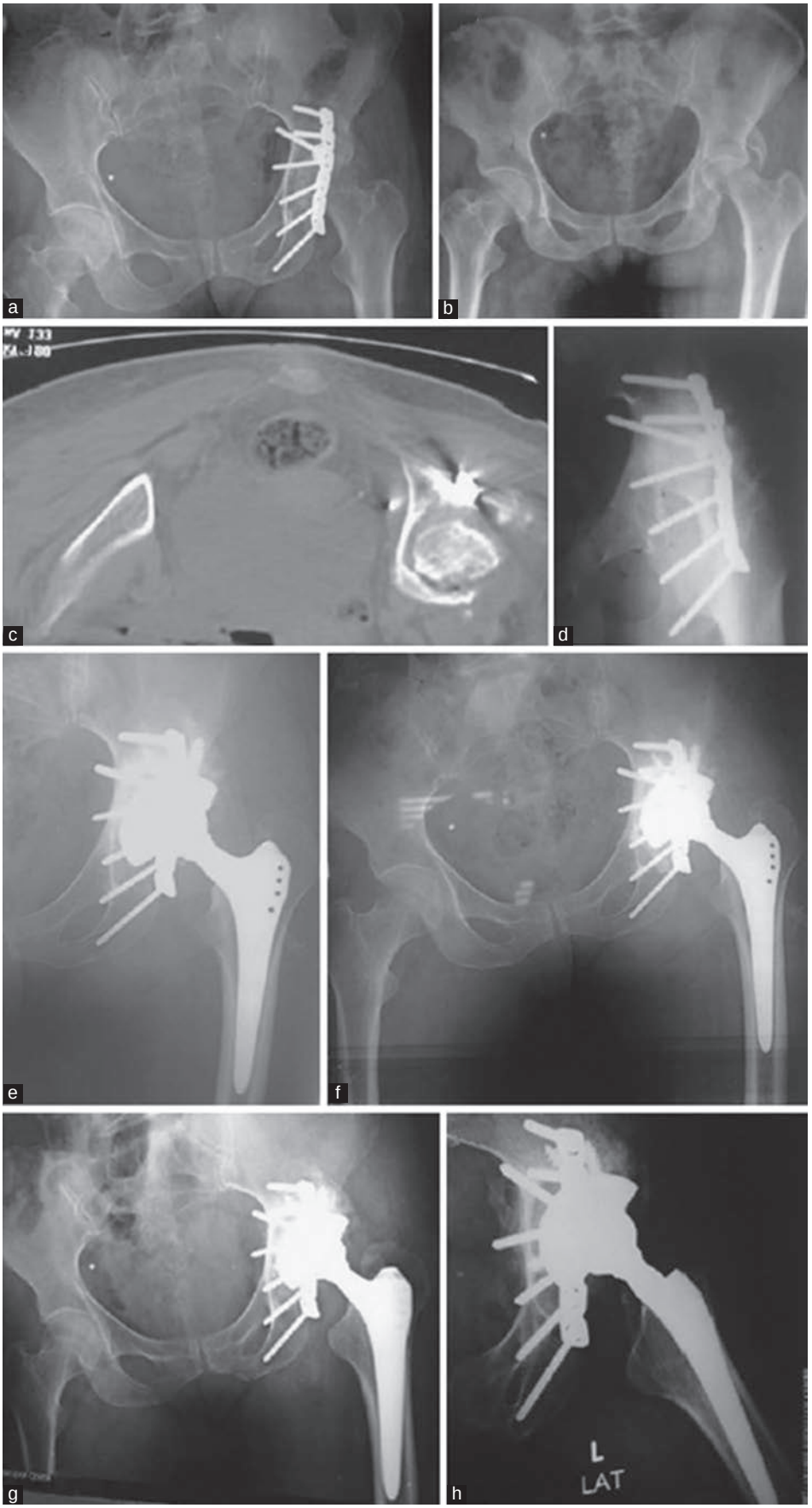
Avascular necrosis (AVN) of the femoral head, traumatic or nontraumatic, is one of the main causes of end-stage degenerative arthritis of the hip in young patients. Five to 12% of total hip arthroplasties (THAs) are due to AVN. There are many techniques to preserve the femoral head with varying degrees of success; however, in the natural course of the disease, femoral head collapse still occurs in some patients, leading to a degenerative hip and even complete loss of function [1]. THA remains the only helpful solution in advanced stages of AVN; however, in the long run, this intervention in young individuals is associated with higher failure rates when compared with the same performed in an older population [2,3]. Moreover, it is believed that there is a difference in the prognosis of THA performed for various etiologies of AVN. The results of THA for AVN are less satisfactory compared with those of THA for other sources of osteoarthritis [4–7]. There exists a debate about the method of fixation of the implants and the best possible bearing combination for these high-demand young patients. The advances in surgical techniques and prostheses designs over the years have improved the overall survivorship of total hip replacement (THR) in general. However, there are mixed reports about the improvement that occurs in patients with AVN [2,7–9].

The aim of this prospective study was to evaluate the clinical and radiographic results of THA in 24 patients with post-traumatic AVN of the femoral head who were younger than 50 years of age at the time of a 60-month follow-up.

Patients and methods

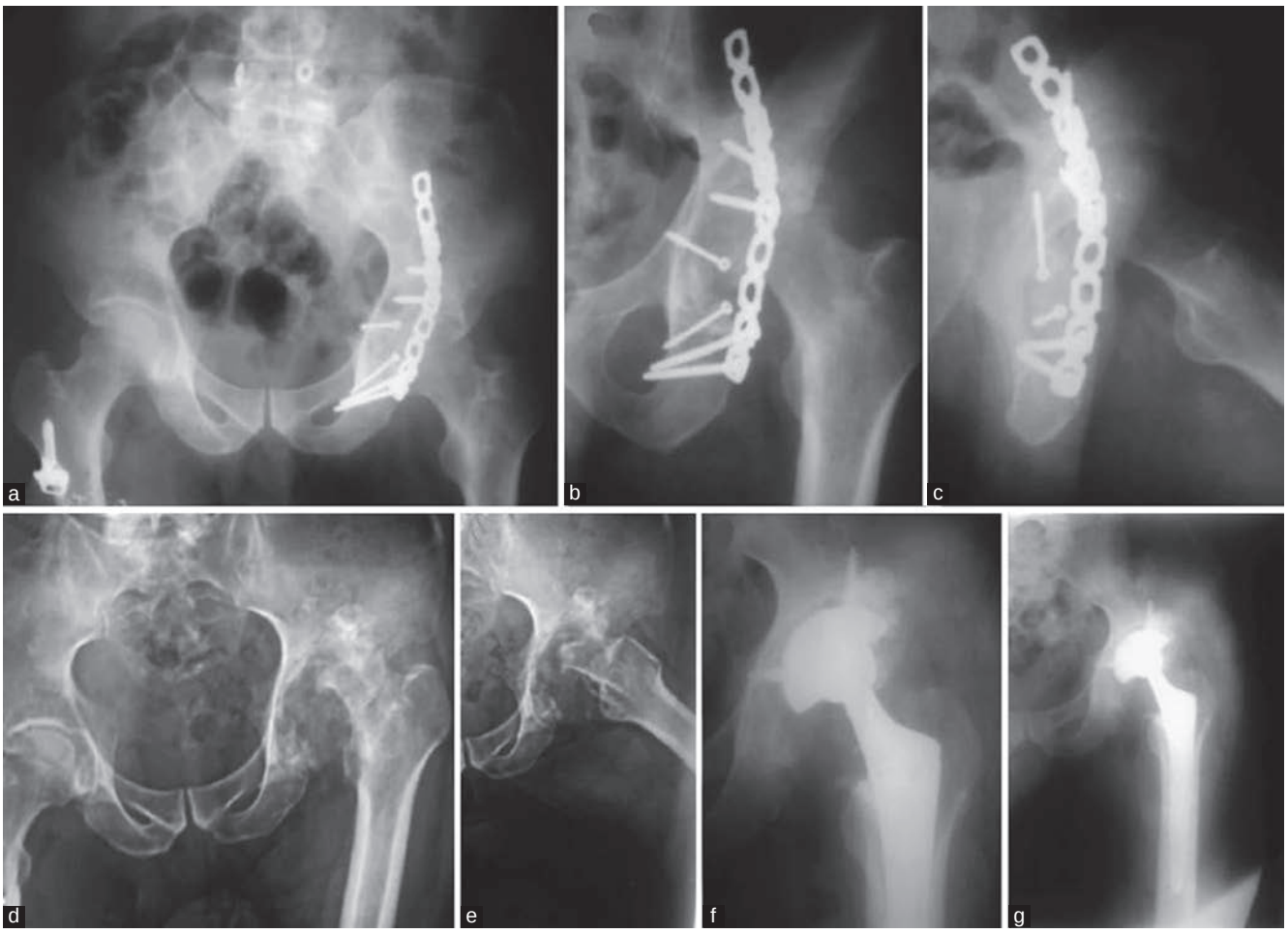
In a prospective study, 24 patients (19 male, five female) with a mean age of 38 years (range 33–45 years) presenting with post-traumatic AVN of the femoral head were operated upon between January 2004 and May 2009 at Zagazig University Hospital. In 12 patients, AVN occurred after internal fixation of the acetabular fractures (Figs 1 and 2): proximal femoral

Figure 1



A 45-year-old female patient with a fractured left acetabulum. (a) Plain radiograph with a fractured left acetabulum; (b) postoperative radiograph after fixation of the acetabulum; (c) plain radiograph after 1 year showing avascular necrosis of the femoral head; (d) computed tomography of the affected hip; (e and f) postoperative radiographs; and (g and h) follow-up radiographs after 3 years.

Figure 2



A 35-year-old male patient with a fractured acetabulum. (a) Plain radiograph showing the fractured left acetabulum after fixation; (b and c) after 9 months with avascular necrosis of the femoral head; (d and e) plain radiograph of the affected hip after removal of the implant; (f) the postoperative radiograph; and (g) the 1-year postoperative radiograph.

fracture in eight patients (Fig. 3) and hip dislocation in four patients (Table 1). Unilateral cementless THA was performed in all patients. The indications for surgery were severe pain and loss of function in the hip joint. Plain radiography was used for the diagnosis in all cases; computed tomography scans were needed in 12 patients with a fractured acetabulum.

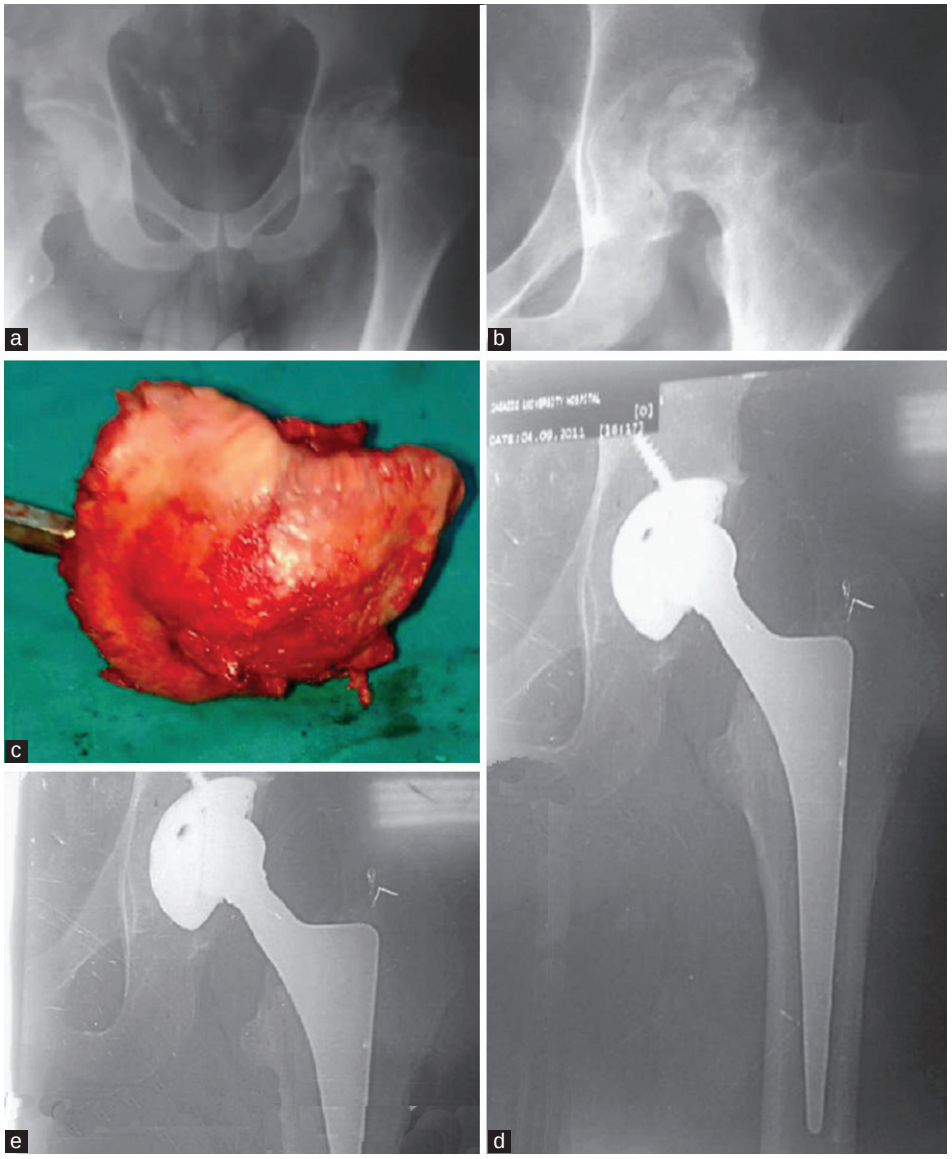
Preoperative parenteral antibiotics and prophylaxis for deep vein thrombosis were used in all patients (60 IU of clexane subcutaneous injection 24 h before operation and 7 days postoperatively). In addition, these patients received oral indomethacin (25 mg) three times a day for 14 days postoperatively for prophylaxis against heterotopic ossification.

All the patients were operated upon in a lateral position; 18 patients received epidural anesthesia and six patients received general anesthesia. The Harding lateral approach was used in all patients. Trochanteric osteotomy was not needed in any patient. Cementless acetabular cups augmented with screws were placed in all the patients (standard cup; Zimmer, USA) with a 28-mm polyethylene bearing. Twelve femoral stems were proximally coated with hydroxyapatite and the other 12 stems were uncoated.

Postoperative protocol

Follow-up visits were conducted at 6 weeks, 3 months, 6 months, 12 months, and annually thereafter. Clinical evaluation was performed using the Harris hip scale [10]. The patients were classified into four standard categories: excellent, good, fair, and poor. Radiographic evaluation was performed using a standard plain radiograph in the anteroposterior and lateral views. The 6-week follow-up radiographs were used to measure the femoral and acetabular component position; the serial and final follow-up radiographs were used to assess fixation and bone remodeling changes. The cup position was assessed according to the criteria of Yoder *et al*. [11] and Massin *et al*. [12]. The cup angle was the lateral (abduction) opening of the cup. The cup height was the vertical distance between the hip rotation center and the horizontal line

Figure 1



A 40-year-old male patient with a fractured femur neck. (a and b) Plain radiographs of the left hip after removal of screws showing avascular necrosis of the femur head; (c) intraoperative image of the femoral head remnant held with a cork screw; and (d and e) the postoperative radiographs.

Table 1 Patient sex and cause of avascular necrosis

	Sex		Type of trauma causing AVN		
	Male	Female	Fractured acetabulum	Fractured proximal femur	Hip dislocation
Number of patients	19	5	12	8	4

AVN, avascular necrosis.

connecting the two teardrops (interteardrop line). The cup medialization distance was measured in reference to a vertical line drawn to the interteardrop line, as outlined by Massin *et al.* [12]. The DeLee and Charnley [13] method was used to assess radiolucencies around the cup.

Radiolucencies and bone remodeling changes in the femoral component were assessed using the method proposed by Engh *et al.* [14]. Radiolucencies greater than 2 mm were defined as significant. Subsidence of the stem was determined by measuring the distance between the tip of the greater trochanter and the superior-lateral shoulder of the stem. Cortical contact of the stem was defined as a distance of less than 1 mm between the stem and the endocortex. Adequate contact was defined as the contact in two or more in

both the anteroposterior and lateral radiographs (four zones in total). Heterotopic ossification was assessed according to the criteria of Brooker *et al.* [15].

Results

Clinical evaluation

The mean follow-up period was 44 months (range 36–60 months). The average period of hospitalization was 12 days (range 10–21 days). The average operative time was 160 min (range 140–200 min). The average blood loss was 1000 ml (range 900–1500 ml). No intraoperative complications were reported. Superficial wound infections were seen in two patients (8%); they were treated with antibiotics and underwent repeated wound dressing. Deep vein thrombosis developed in one patient (4%) in the first postoperative month, and the patient received medical treatment. Deep infection was reported in one patient in the third postoperative month, which was treated by aggressive debridement and insertion of septocol sheets and parenteral third-generation cephalosporin antibiotics according to culture sensitivity for 2 weeks, followed by oral antibiotics for another 2 weeks; this patient did not need revision until 50 months postoperatively. Stage 1 heterotopic ossification was seen in three patients (12%); however, no patients were stage 2 or stage 3.

The mean Harris hip score [13] improved from 40 (preoperatively) to 80 (3 years postoperatively). Six patients had an excellent score, 14 had a good score, three had a fair score, and one patient had a poor score. Improvements were seen in the range of motion in all patients when compared with the preoperative period. The mean flexion improved from 60° (range 40–80°) to 110° (range 80–120°). The internal rotation increased from 15° (range 10–25°) preoperatively to 30° (range 25–35°) postoperatively. External rotation increased from 25° (range 20–30°) to 40° (range 35–45°). Abduction improved from 20° (range 15–30°) to 45° (range 35–50°) and adduction from 18° (range 10–25°) to 30° (range 25–35°).

Radiographic evaluation

The cup position measurements for all patients were within the normal range. The mean cup angle was 40° (range 35–55°); the mean cup height was 25 mm (range 20–30 mm); and the mean cup medialization distance was 30 mm (range 20–40 mm). The stem was centralized in 18 patients, was in the varus position in four patients, and was in the valgus position in two patients.

Three stems (12%) developed radiolucency at two zones (zones I and II), but these did not prove to be loose. Two patients had acetabular osteolysis in zone III. Femoral osteolysis in zones III and IV was observed in three patients at 50 months after surgery. Two patients (8%) needed revision after 55 months of follow-up for aseptic loosening of the cups (vertical migration of 6 mm and loosening in three zones) (Table 2).

No difference in the outcome was found between the type of trauma after AVN (acetabular fractures, proximal femoral fractures, or pure dislocation) as regards the changes in preoperative and postoperative Harris hip scores ($P > 0.05$).

Discussion

AVN of the femoral head is a condition that often results in collapse of the femoral head and secondary osteoarthritis of the hip. Many authors have reported that the long-term outcomes of procedures such as intertrochanteric osteotomy, core decompression, and superficial arthroplasty, which can be considered as prophylactic, are poor [16–19]. The main goal in young patients is to preserve the normal bone stock; however, THR is indicated when pain and loss of function are severe. THR in patients with high demands and active lifestyle carries the risk of early loosening and repeated revisions. To overcome these problems, more durable bearing materials have been developed [20]. Large-diameter metal-on-metal resurfacing arthroplasty has been advocated as a bone-sparing procedure for young active patients. With more than 10 years of follow-up, there is, at present, insufficient evidence to determine whether modern metal-on-metal resurfacing offers advantages over standard cementless THA. The occurrence of high metal ion concentrations after the implantation of large-diameter metal-on-metal articulations raises serious concerns for their use in women of a child-bearing age. Incidences of

Table 2 Clinical and radiological results

	Mean Harris hip score		Radiographic evaluation (radiolucency on radiography)						
	Preoperative	Postoperative	Acetabular cup				Femoral stem		
	40 SD 2.3	80 SD 2.3	One zone	Two zones	Three zones + loosening	Revision	Zones I and II	Zones III and IV	Loosening
Number of patients			2 (zone III)	0	2	2	3	3	2

Table 3 Comparison with some authors in terms of the results of cementless total hip replacement in avascular necrosis

References		Follow-up (years)	Hips	Revision rate (%)
Salvati and Cornell [23]	Cement/cement	8	28	37
Kim *et al.* [24]	Cementless	7.2	78	21.8
Piston *et al.* [25]	Cementless	7.5	35	6
Lins *et al.* [26]	PCA THA/proximal	5	37	8.1
This study	Cementless	5	24	8

PCA, porous coated anatomic; THA, total hip arthroplasty.

symptomatic and asymptomatic pseudotumors have also been reported [21,22].

Cementless fixation of prostheses in THA still has the advantages of longevity and easy revision. The early results of cementless THA are superior to those of cemented THA, even with advances in cementing techniques. Salvati and Cornell [23] reported a failure rate of 37% after a mean follow-up period of 8 years after THA with cement in patients with AVN (Table 3). Stauffer [27], however, found the femoral loosening rate to be 50% after a mean follow-up period of 10 years. Lins *et al.* [26] reported that after a mean follow-up period of 60 months, 81% of femoral components and 97% of acetabular components were stable in 37 hips with AVN, which they treated with cementless THA. Two cases of deep infection were reported in the same study: one in the early and the other in the late postoperative period. Although heterotopic ossification developed in 35% of cases, none of them reached stages 3 or 4. Piston *et al.* [25] performed THA in 35 hips of 30 patients with an average age of 32 and reported a revision rate of 6% after an average follow-up period of 7.5 years. In the study of Celebi *et al.* [28], they reported deep infection in one case and stage 2 heterotopic ossifications (6%) in two.

Therefore, as seen from the results of the above-mentioned studies, the clinical and radiological outcomes of AVN in the femoral head obtained with cementless THA appear to be superior to those of THA with cement.

In our study, cementless THA was performed in all patients, with good results up to 60 months of follow-up and revisions in two patients (8%). No intraoperative complications were reported in this study. Superficial wound infections were seen in two patients (8%) who were treated with antibiotics and underwent repeated wound dressing. Deep infection was reported in one patient during the third postoperative month that was treated by aggressive debridement and insertion of septocol sheets and parenteral third-generation cephalosporin antibiotics. Deep vein thrombosis developed in one patient (4%) in the first postoperative month and the patient received medical treatment. Stage 1 heterotopic ossification despite prophylactic therapy was seen in three patients (12%) but without function impairment. Another complication associated with THA for AVN of the femoral head is dislocation in the early and late period. Kim *et al.* [24] reported that dislocations occurred in the early period in three of 116 patients in whom they performed cementless THA because of AVN of the femoral head. Another case of dislocation occurred in a patient in the 49th postoperative month. Dislocation in the late period has been attributed by the researchers to the overabduction positioning of the acetabular component. In our study, we did not encounter any case of early or late dislocation. We can attribute this absence of dislocations to the avoidance of positioning the acetabular components in overabduction, good component anteversion, and absence of other pathological changes that occur in nontraumatic AVN.

Conclusion

The management of traumatic AVN of the femoral head in young and active patients continues to be a challenge. The results of cementless hip arthroplasties are satisfactory and encouraging in treating this challenging group of patients.

Acknowledgements

Conflicts of interest

There are no conflicts of interest.

References

1 Hartley WT, McAuley JP, Culpepper WJ, Engh CA Jr, Engh CA Sr. Osteonecrosis of the femoral head treated with cementless total hip arthroplasty. J Bone Joint Surg 2000; 82-A:1408–1413.

2 Ortiguera DJ, Pulliam IT, Cabanela ME. Total hip arthroplasty for osteonecrosis. Matched-pair analysis of 188 hips with long-term follow-up. J Arthroplasty 1999; 14:21–28.

3 Restrepo C, Lettich T, Roberts N, Parvizi J, Hozack WJ. Uncemented total hip arthroplasty in patients less than twenty years. Acta Orthop Belg 2008; 74:615–622.

4 Brinker MR, Rosenberg AG, Kull L, Galante JO. Primary total hip arthroplasty using non-cemented porous-coated femoral components in patients with osteonecrosis of the femoral head. J Arthroplasty 1997; 12:683–688.

5 Chiu KH, Shen WY, Ko CK, Chan KM. Osteonecrosis of the femoral head treated with cementless total hip arthroplasty. A comparison with other diagnoses. J Arthroplasty 1997; 12:683–688.

6 Dudkiewicz I, Covo A, Salai M. Total hip arthroplasty after avascular necrosis of the femoral head: does etiology affect the results?Arch Orthop Trauma Surg 2004; 124:82–85.

7 Katz RL, Bourne RB, Rorabeck CH, McGee H. Total hip arthroplasty in patients with avascular necrosis of the hip. Follow-up observations on cementless and cemented operations. Clin Orthop Relat Res 1992; 281:145–151.

8 Berger RA, Jacobs JJ, Quigley LR, Rosenberg AG, Galante JO. Primary cementless acetabular reconstruction in patients younger than 50 years old. 7- to 11-year results. Clin Orthop Relat Res 1997; 344:2216–2226.

9 Collis DK. Long-term (twelve to eighteen-year) follow-up of cemented total hip replacements in patients who were less than fifty years old. A follow-up note. J Bone Joint Surg 1991; 73:593–597.

10 Harris WH. Traumatic arthritis of the hip after dislocation and acetabular fractures: treatment by mold arthroplasty. An end-result study using a new method of result evaluation. J Bone Joint Surg Am 1969; 51:737–755.

11 Yoder SA, Brand RA, Pedersen DR, O'Gorman TW. Total hip acetabular component position affects component loosening rates. Clin Orthop Relat Res 1988; 228:79–87.

12 Massin P, Schmidt L, Engh CA. Evaluation of acetabular component migration. An experimental study. J Arthroplasty 1988; 4:245–251.

13 DeLee JG, Charnley J. Radiologic demarcation of cemented sockets in total hip replacement. Clin Orthop Relat Res 1976; 121:20–32.

14 Engh CA, Massin P, Suthers KE. Roentgenographic assessment of the biologic fixation of porous surfaced femoral components. Clin Orthop Relat Res 1990; 257:107–128.

15 Brooker AL, Bowerman JW, Robinson RA, Riley LH Jr. Ectopic ossification following total hip replacement. Incidence and a method of classification. J Bone Joint Surg Am 1973; 55:1629–1632.

16 Kenzora JE. Treatment of idiopathic osteonecrosis: the current philosophy and rationale. Orthop Clin North Am 1985; 16:717–725.

17 Meyers MH. Resurfacing of the femoral head with fresh osteochondral allografts. Long-term results. Clin Orthop Relat Res 1985; 197:111–114.

18 Stulberg BN, Davis AW, Bauer TW, Levine M, Easley K. Osteonecrosis of the femoral head. A prospective randomized treatment protocol. Clin Orthop Relat Res 1991; 268:140–151.

19 Sugioka Y. Transtrochanteric rotational osteotomy in the treatment of idiopathic and steroid-induced femoral head necrosis, Perthes' disease, slipped capital femoral epiphysis, and osteoarthritis of the hip. Indications and results. Clin Orthop Relat Res 1984; 184:12–23.

20 Simon JP, Berger P, Bellemans J. Total hip arthroplasty in patients less than 40 years old with avascular necrosis of the femoral head. A 5 to 19-year follow-up study. Acta Orthop Belg 2011; 77:53–60.

21 Jiang Y, Zhang K, Die J. A systematic review of modern metal-on-metal total hip resurfacing vs standard total hip arthroplasty in active young patients. J Arthroplasty 2011; 26:419–426.

22 Mc Grory B, Barrack R, Lachiewicz E. Modern metal-on-metal resurfacing. J Am Acad Orthop Surg 2010; 18:306–314.

23 Salvati EA, Cornell CN. Long-term follow-up of total hip replacement in patients with avascular necrosis. Instr Course Lect 1988; 37:67–73.

24 Kim YH, Kim JS, Cho SH. Primary total hip arthroplasty with a cementless porous-coated anatomic total hip prosthesis: 10- to 12-year results of prospective and consecutive series. J Arthroplasty 1999; 14:538–548.

25 Piston RW, Engh CA, De Carvalho PI, Suthers K. Osteonecrosis of the femoral head treated with total hip arthroplasty without cement. J Bone Joint Surg Am 1994; 76:202–214.

26 Lins RE, Barnes BC, Callaghan JJ, Mair SD, McCollum DE. Evaluation of uncemented total hip arthroplasty in patients with avascular necrosis of the femoral head. Clin Orthop Relat Res 1993; 297:168–173.

27 Stauffer RN. Ten-year follow-up study of total hip replacement. J Bone Joint Surg Am 1982; 64:983–990.

28 Celebi L, Hilmi HM, Aksahin E, Mehmet FY, Yuksel HY. Cementless total hip arthroplasty in patients with avascular necrosis of the femoral head. Acta Orthop Traumatol Turc 2006; 40:105–110.