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Cementless total hip arthroplasty in patients with avascular necrosis of the femoral head

Femur başı avasküler nekrozu olan hastalarda çimentosuz total kalça artroplastisi

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Amaç: İleri evre femur başı avasküler nekrozu olan hastalarda çimentosuz total kalça artoplastisi sonuçları değerlendirildi.

Çalışma planı: Femur başı avasküler nekrozu nedeniyle 25 hastaya (19 erkek, 6 kadın; ort. yaş 39.6; dağılım 26-56) tek taraflı çimentosuz total kalça artroplastisi uygulandı. Asetabuluma çimentosuz, vidalı asetabuler kaplar yerleştirildi. Femurda ise çimentosuz femoral komponentler kullanıldı. Hastalar fonksiyonel olarak Harris kalça skoru ile değerlendirildi. Radyografik değerlendirmede, asetabuler komponent için Lins ve ark.nın, femoral komponent için de Engh ve ark.nın ölçütleri kullanıldı. Heterotopik osssifikasyon Brooker ve ark.nın sınıflandırmasına göre değerlendirildi. Hastalar ortalama 63.9 ay (dağılım 48-94 ay) takip edildi.

Sonuçlar: Ameliyat öncesinde ortalama 41.5 (dağılım 33-52) olan Harris kalça skoru son kontrollerde 87.1 puana (dağılım 74-96) yükseldi ($p<0.001$). Yirmi iki olguda (88%) radyografik olarak gevşeme bulgusuna rastlanmadı. Bir hastanın asetabuler komponentinde, iki hastanın femoral komponentinde radyolusen hatlar saptandı; ancak, bu olgular klinik olarak asemptomatik olduklarından ek girişim uygulanmadı. Sekiz hastada evre 1, iki hastada evre 2, üç hastada da evre 3 heterotopik ossifikasyon görüldü.

Çıkarımlar: Femur başı avasküler nekrozu nedeniyle total kalça artroplastisi uygulanan hasta grubu osteoartrit grubuna göre daha genç ve aktif olduğundan, bu hastalar yaşamları boyunca daha fazla sayıda revizyon cerrahisiyle karşı karşıya kalacaklardır. Bulgularımız, bu hasta grubunda çimentosuz uygulamanın daha uygun olduğunu desteklemektedir.

Anahtar sözcükler: Artroplasti, replasman, kalça; çimento/kemik; femur başı nekrozu/etyoloji/cerrahi/radyografi; kalça eklemi/radyografi.

Objectives: We assessed the results of cementless total hip arthroplasty in patients with late-stage avascular necrosis of the femoral head.

Methods: Unilateral cementless total hip replacement was performed in 25 patients (19 males, 6 females; mean age 39.6 years; range 26 to 56 years) with avascular necrosis of the femoral head. A cementless acetabular cup with screws was used for the acetabulum with a cementless femoral component. Functional results were evaluated according to the Harris hip score. Radiographically, acetabular and femoral components were evaluated according to the criteria of Lins et al. and Engh et al., respectively. Heterotopic ossification was assessed according to the criteria of Brooker et al. The mean follow-up was 63.9 months (range 48 to 94 months).

Results: The mean Harris hip score increased from 41.5 (range 33 to 52) to 87.1 (range 74 to 96) after the treatment ($p<0.001$). No radiographic loosening was detected in 22 patients (88%). Radiolucent lines were observed in one acetabular and two femoral components, but no secondary interventions were performed as the patients were asymptomatic. Heterotopic ossification was observed in 13 patients, which was grade 1 in eight patients, grade 2 in two patients, and grade 3 in three patients.

Conclusion: In general, patients who undergo total hip arthroplasty for avascular necrosis of the femoral head are younger and more active compared to those with osteoarthritis, showing a high likelihood of future revision procedures. Our results favor cementless applications as a more appropriate alternative in this patient group.

Key words: Arthroplasty, replacement, hip; cements/bone; femur head necrosis/etiology/surgery/radiography; hip joint/radiography.

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Avascular necrosis of the femur head is a condition often results in the collapse of the femoral head and secondary osteoarthritis of the hip. It is most frequently seen in patients between ages 20 and 50, and etiological factor cannot be shown in about 20% of the case.[1,2] The long-term outcomes of the prophylactic applications in Ficat stage 3-4 patients.[3-6] are known to be bad, Total hip arthroplasty is seen as the main therapeutic option in such cases of advanced stages. It has been reported that the failure ratios in patients that total hip arthroplasty has been performed because of avascular necrosis of the femoral head is higher than in those arthroplasty has been performed because of other causes.[7-10] The expectation of revision surgery in such patients because of their younger ages and their better bone quality bring forth the discussions of applications with and without cement, particularly regarding the femoral components.

In this study, results of cemetless total hip arthroplasty in patients with advanced stage femoral head avascular necrosis were evaluated.

Patients and Method

Unilateral cementless total hip arthroplasty was performed between 1994 and 1998 on 26 patients with avascular femoral head necrosis (Figure 1a). Indication for surgery in patients with Ficat stage 3 and 4 were severe pain in hip that did not respond to conservative treatment.[11] Diagnosis was made according to clinical and radiological findings. One patient that revision arthroplasty surgery was performed because of deep infection was excluded from the study, and evaluation was performed on 25 patients (19 males and 6 females; average age 39.6 ± 8.1; range 26-56). Four patients (16%) were Ficat stage 3 and 21 (84%) were Ficat stage 4. All patients were evaluated as regards bilateral involvement. Sixteen patients (64%) that counterlateral hip involvement could not be shown with plain x-rays were evaluated with bone scintigraphy. Etiology of the avascular necrosis was use of corticosteroids in 9 patients (36%), alcohol abuse in 2 (8%), and sickle cell anemia in one (4%). Thirteen patients that no etiological factor could be found were considered as idiopathic femoral head avascular necrosis.

All the patients were operated under general anesthesia in supine position using the anterolateral approach (Harding). Trochanteric osteotomy was performed in none. Following the chiseling according to the acetabulum, cementless screw acetabular cups were placed (Standard cup, Protek AG, Münsingen - Berne, Switzewrland). Cups were fixed onto the acetabulum with at least two acetabular screws in each case. Then, very high molecular weight polyethylene inserts with diameters fitting acetabular cups were placed. Cementless femoral components (CLS cementless total hip replacement system, Protek AG, Münsingen - Berne,

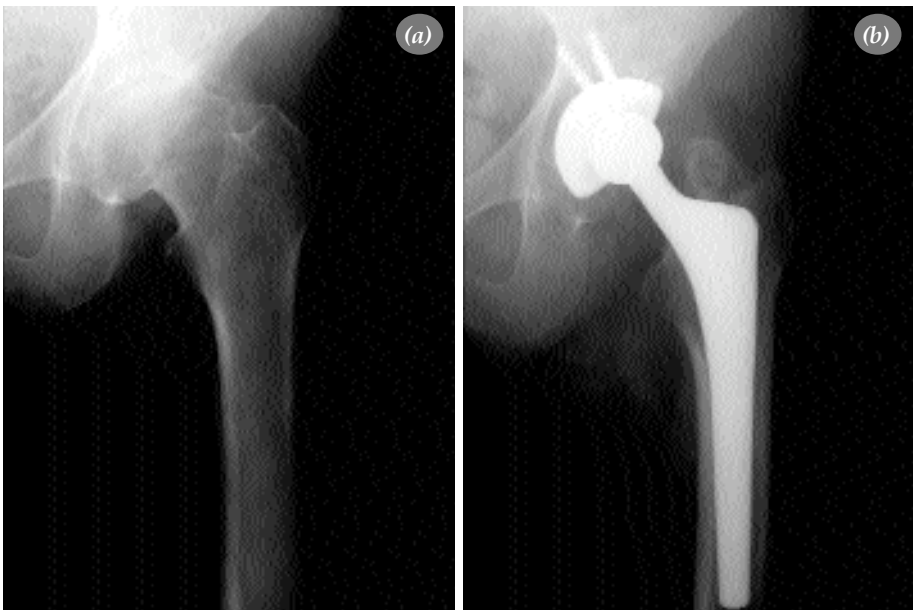

Figure 1. Preoperative **(a)** and postoperative 52th months **(b)** radiographs of a Ficat Stage 4 patient.

Switzewrland) were used in the femur following a suitable scraping (Figure 1b). Capsule was excised in all the cases, and capsule repair was not performed. All the operations were performed by the same surgeon.

Figure 1. X-rays of a patient in Ficat stage 4 (a) before, and (b) 52 months following the surgery.

First generation cephalosporin started one hour prior to the surgery was used for five days with the purpose of infection prophylaxis. Enoxaparin 4000 IU/day was used for 10 days to reduce the risk of venous thromboembolism. Indomethasine was used with a dosage of 50 mg b.i.d. for 7 days for heterotopic ossification prophylaxis.

Isometric and isotonic exercises were started within and on the side bed at postoperative Day 1. Patients were mobilized on Day 2 with the help of walkers without giving full weight to their operated extremities. Patients were trained before discharge to walk using clutches by giving their weight only partially to their operated extremities. Clutches were used for 3 months. Clutches were discarded at the end of the 3rd month and walking by giving full weight to the operated extremities was started. Clinical and radiological follow-ups were performed every three months within the first year, every six within the second year, and annually afterwards. Patients were evaluated functionally according to Harris hip scores in the final follow-ups.[12] In the radiographical evaluations, measures of Lins et al[13] were used for acetabular component, and measures of Engh et al[14] for the femoral component. Evaluation of heterotopic ossification was performed according to the classification of Brooker et al[15] Patients were followed for an average period of 63.9 ± 14.9 months (range = 48 – 94 months).

Statistical analysis

Difference between the pre- and postoperative hip scores was evaluated with paired t-test. Cases with unilateral avascular necrosis and cases with bilateral avascular necrosis were compared with each other as regards pre- and postoperative hip scores and improvements in hip scores using Student's t-test. Relation between the Ficat stage of the operated side and pre- and postoperative hip scores, and the improvement in the hip score were compared using Mann Whitney U-test. Relation between the development of heterotopic ossification and postoperative hip score and the improvement in the hip score were compared using Student's t-test.

Results

There was bilateral involvement in 16 (64%) patients. Seven of the hips that total hip arthroplasty was not performed were evaluated as Ficat stage 1, six as stage 2, and three as stage 3. Core decompression was performed and all the Ficat stage 1 and 2 hips, and conservative therapy were applied to stage 3 hips.

Hospitalization period was 8 days in the average (range = 6-14 days). Average operation period for arthroplasty applications was 134 minutes (range = 105-165 minutes). The average amount of bleeding was 950 ml (range = 700-1470ml).

None of the patients developed complications during the operations. Superficial wound site infections were seen in the early postoperative period in two of the patients (8%). Infection retreated in both patients with treatment with antibiotics and local wound care. No clinical or radiological infection findings were seen in the final controls of these patients. Deep vein thrombosis developed in one patient (4%) in the third month that retreated with medical treatment.

Deep infection (S. aureus) was found in one patient in the fourth month. Treatment of the infection with antibiotic therapy was not possible in this patient, and aggressive debridement was performed. When it was still not possible to treat the infection, two-stage replacement with bone cement containing antibiotics was performed. No findings of infection were seen in the final controls of this patient who was not included in the evaluation.

Stage 1 heterotopic ossification was seen in 8 patients (32%), stage 2 in two (8%), and stage 3 in three (12%). Two of the patients out of three with stage 3 heterotopic ossification had a flexion restriction of 200, and the remaining one had a restriction of 300. However, pain was not significant in any of these patients.

Final controls

Improvements were seen in the range of motion in all the patients in the final controls as compared to preoperative period. While the flexion contracture receded averagely 40 (range 0° - 15°), hip flexion increased

to 107 degrees from 92 degrees (80° - 120°), internal rotation increased to 31 degrees (25° - 35°) from 17 degrees (10° - 25°), external rotation to 39 degrees (35° - 45°) from 30 degrees (25° - 35°), abduction to 43 degrees (40° - 50°) from 28 degrees (25° - 40°), and adduction to 29 degrees (25° - 35°) from 19 degrees (10° - 25°).

The Harris hip score, which was averagely 41.5 ± 5.6 (range 33-52) preoperatively, reached 87.1 ± 5.7 (range 74-96) in the final controls. It was found that the increase in Harris hip score was significant ($p < 0.001$).

No statistically significant difference was found between patients with unilateral avascular necrosis and those with bilateral involvement as regards pre- and postoperative hip scores ($p > 0.05$) and improvements in hip scores ($p > 0.05$).

No statistically significant difference was found between the Ficat stages of the hips operated and pre- and postoperative hip scores and improvements in hip scores ($p > 0.05$).

There was no statistically significant relationship between development of heterotopic ossification and pre- and postoperative hip scores and improvements in hip scores ($p > 0.05$).

Findings of loosening in acetabular and femoral components were not seen in 22 patients (88%) radiographically. Revision surgery was not performed in any of the patients because of aseptic loosening. Although marked radiolucent lines were observed in the acetabular component of one patient (4%), and in femoral components of two (8%), no additional operations were performed on these patients, since all were asymptomatic clinically. We believe that revision surgeries will be needed in these in the following years.

Discussion

Avascular necrosis of the femoral head is a condition often results in the collapse of the femoral head and secondary osteoarthritis of the hip.

It is know that the long-term outcomes of the applications like intertrochanteric osteotomy, core decompression, and superficial arthroplasty, which can be considered as prophylactic, are bad.[3-6] Hemiarthroplasty or total hip arthroplasty face as the main treatment option in such patients with advances stage disease. It is seen from the large-scale studies on total hip arthroplasty that 5-12% of the operations are performed because of avascular necrosis.[10,16,17] In addition, it has been reported that the rate of failure in patients that total hip arthroplasty has been performed because of avascular necrosis are higher as compared to patients of the same age group operated with other reasons7-10. Various reasons have been suggested related to the high rates of failure in this age group.[8-10] Among these, continuing of the systemic disease, mineral metabolism defects related to the use of corticosteroids, high activity levels in young patients, obesity, and involvement of the calcar femorale as well as the femoral head can be listed.

Salvati and Cornell[18] reported a failure rate of 37% after a mean follow-up period of eight years after total hip arthroplasty with cement in patients with avascular necrosis. Stauffer[19] however, found the femoral loosening rate to be 50% after mean follow-up period of ten years. Saito et al.[20] reported the unsatisfactory outcome rate as 48%, and attributed this result to intense bone necrosis. Garino and Steinberg[21] however, performed revision surgeries with a rate of 4% in 123 hips of 85 patients after a mean follow-up period of 4.6 years thanks to the new cementing techniques and implants. Authors emphasized that the outcomes of total hip arthroplasty with cement could be excellent as well in patients with avascular necrosis with the use of new cementing techniques and implants.

In our study, cementless total hip arthroplasty was performed on Ficat stage 3 and 4 patients whose severe pain could not be treated with conservative treatments. No significant differences were found between the stage 3 and 4 patients in terms of pre- and postoperative hip scores and improvements in the hip scores. The following conclusions can be deduced from these results. First, there are no significant differences between stages 3 and 4 according to Ficat staging, which is mainly an anatomical staging system. Second, cementless total hip arthroplasty creates no significant differences as regards postoperative healing between stage 3 and 4 patients. In this case, in stage 3 patients that acetabular cartilage is not involved in the disease, bipolar hemiarthroplasty can be regarded as a treatment option, considering the condition of the acetabular cartilage. However, we belive that studies of larger scales and longer periods of follow-up indicating the

reliability of bipolar hemiarthroplasty are required.

Lins et al.[13] reported after a mean follow-up period of 60 months that 81% of the femoral components, and 97% of the acetabular components were stable in the 37 hips with avascular necrosis they treated with cementless total hip arthroplasty. Two deep infection cases were reported in the same study, one in early, and the other in late postoperative periods. Although heterotopic ossification developed in 35% of the cases, none of them reached stages 3 or 4. Piston et al.[22] performed total hip arthroplasty in 35 hips of 30 patients with an average age of 32, and reported the revision rate as 6% after an average follow-up period of 7.5 years. In this study also, deep infection developed in one case, and stage 2 heterotopic ossification (6%) in two. As seen, clinical and radiographical outcomes of avascular necrosis in femoral head obtained with cementless total hip arthroplasty appear to be superior to total hip arthroplasty with cement. Xenakis et al.[23] performed cementless total hip arthroplasty on patients with avascular necrosis and osteoarthritis, with 29 patients in each group, and obtained results in the avascular necrosis group that were comparable to those in osteoarthritis group.

In our study, two cases with radiolucent lines were evaluated as failures although they were asymptomatic, and the rate of failure was found to be 8% at the end of average 63.9 months. The deep infection seen in another patient who was excluded from the evaluation later was successfully treated with a two-stage replacement. No clinical or radiological findings of infection were found in the final control of this patient. If this patient also is included in the rate of failures, then the failure rate in our study increases to 15%.

Dudkiewics et al.[24] evaluated the effect of the etiology of avascular necrosis on the results, and reported that the final functional outcomes were not effected from the etiology; however, the lifespan of the implant in avascular necrosis related to the use of corticosteroids was shorter. We did not see any evidence indicating this. One case used corticosteroids out of three that were evaluated as failures because of radiolucent lines in x-rays, and the remaining two were evaluated as idiopathic. Heterotopic ossification found in 52% of our cases was evaluated as stage 3 in three (12%). It was seen that heterotopic ossification was a more frequently encountered problem in cementless femoral component applications. Interestingly, however, heteropic ossification in avascular necrosis treatments is not encountered as an important problem, even in cementless applications. Particularly state 3 and 4 heterotopic ossifications are almost never seen. This has been shown also by Ritter and Meding[25] also. It has been suggested that the lower heterotopic ossification rates in osteonecrosis patients could be related to the lower bone quality.[13]

In our study, the rate of heterotopic ossification is high (52%) in spite of prophylactic therapy; and it was evaluated as stage 3 in three patients (12%). Together with this, development of heterotopic ossification was found related to neither postoperative hip scores nor improvement in the hip scores. Hip flexion was restricted, which we related to heterotopic ossification, in patients that stage 3 heterotopic ossification had developed. This condition can be related to the lateral approach, which was used in all the patients, since prophylaxis with indomethasine that we used for 7 days with a dosage of 2x50mg has been shown to be effective.[26]

Another problem that might be encountered following the total hip arthroplasty applications in the avascular necrosis of femoral head are dislocations in early and late periods. Kim et al.[27] reported that dislocations occurred in the early period in three cases out of 116 that they performed cementless total hip arthroplasty because of avascular necrosis of femoral head; and dislocation occurred in another one in 49th month postoperatively. Dislocation in the late period has been attributed by the researchers to over-abduction positioning of the acetabular component. In the same study, the recurrent subluxation seen in the 65th month was attributed to the excessive wear of polyethylene. The important differences of this said study from ours, in our opinion, is that the operations have been performed with posterolateral (Gibson) and posterior (Moore) approaches, and that femoral heads of 32mm were used in all the cases. Schneider and Knahr[28] treated a dislocation they saw in the early postoperative period with replacing the modular femoral head with the purpose of elongating the femoral neck. We can attribute the absence of dislocations in our study to avoidance of positioning the acetabular components in over-abduction, ensuring the appropriate femoral compo-

nent anteversion, using 28-mm femoral heads, and the meticulous rehabilitation program applied postoperatively.

The patient group that total hip arthroplasty is performed because of avascular necrosis of the femoral head is younger as compared to the osteoarthritis group. The average age in our study is 39.5, and only three patients (12%) were over 50 years of age. It is certain that such a patient group has a more active was of living than the group that total hip arthroplasty is performed because of osteoarthritis. Therefore, these patients will suffer revision surgeries in greater numbers throughout their lives. Comparative studies and the findings of our study indicate that the outcomes of the cementless applications are superior to those of applications with cement.

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