Orijinal Araştırma / Case Report

Turk J Hip Surg 2022;2(2):184-188
https://10.5505/TJHS.2022.69875

Türkiye Kalça Cerrahisi Dergisi
Turk J Hip Surg

Baş Nekrozunun Derecesi, Demografik veya Etiyolojik Değişkenlerden Ziyade, Femur Başı Avasküler Nekrozunda Kollaps Sıklığını Belirler

Extent of Head Necrosis Rather Than Demographic or Etiologic Variables, Determines The Frequency of Collapse at Avascular Necrosis of Femoral Head

Selahaddin Aydemir, Emre Acar, Cihangir Türemiş, Onur Hapa

Dokuz Eylül Üniversitesi Tıp Fakültesi, Ortopedi ve Travmatoloji Ana Bilim Dalı, İzmir

Geliş / Received: 21.11.2021 **Kabul / Accepted:** 27.12.2022 **Online Yayın / Published Online:** 29.12.2022
Cite as: Aydemir S. , Acar E., Türemiş C., Hapa O., Baş nekrozunun derecesi, demografik veya etiyolojik değişkenlerden ziyade, femur başı avasküler nekrozunda kollaps sıklığını belirler
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ÖZET

Kemik iliği aspirat konsantresi (BMA), osteonekrozun erken evrelerinde en sık kullanılan cerrahi olan core dekompresyonun (CD) etkinliğini değişken sonuçlarla arttırır. Bu çalışmanın amacı, kollaps (evre IV) ve kollaps olmayan hastalar arasında femur başı osteonekrozu olan hastalarda (n: 30), lezyonun yaygınlığı veya evresi, ağrı skorları, sigara içme alışkanlığı, steroid kullanımı değişkenlerini karşılaştırmaktı. Demografik değişkenler (yaş, cinsiyet), takip süresi, ameliyat öncesi VAS, ameliyat sonrası VAS, memnuniyet skorları, sigara içme sıklığı, steroid kullanımı, Ficat-Arlet evresi çökmüş (n: 24) ve çökmemiş kalçalar (n: 18) arasında farklılık göstermedi (p>0. İki grup arasındaki tek fark Kerbaul açısı (p: 0.003), nekrotik indeksti (p: 0.03) ve çökmüş hastalarda ikisi de daha yüksekti (228±380 vs180±540, 38±13 Vs 29 ± 17). Çökmüş hastalarla çökme olmayan hastalar karşılaştırıldığında ağrı ve tatmin olma dereceleri benzer iken hastalığın ilerlemesi veya başın çöküşü, demografik veriler ve etyolojik faktörlerden ziyade hastalığın baştaki tutulum miktarına bağlıdır.

Anahtar Kelimeler: *Femur başı osteonekroz; Kerboul açısı; nekrotik indeks*

ABSTRACT

Bone marrow aspirate concentrate (BMA) enhances the efficacy of core decompression (CD) which is the most commonly used surgery in the early stages of osteonecrosis with variable results. The purpose of the present study was to compare collapsed (stage IV) and noncollapsed patients (n: 30) that have osteonecrosis of the femoral head, in terms of variables, extent or stage of the lesion, pain scores, smoking habit, steroid usage. Demographic variables (age, sex), follow-up time, preop VAS, postop VAS, satisfaction point, frequency of smoking, and steroid usage, Ficat—Arlet stage were not different between collapsed (n: 24) and noncollapsed hips (n: 18) (p>0.05). The only difference between the two groups was Kerbaul angle (p: 0.003), and necrotic index (p: 0.03), which were higher in collapsed patients (228±380 vs180±540, 38±13 Vs. 29±17). Collapse or progress of disease mainly depends on the extent of the disease rather than demographic or etiologic factors, while collapsed patients report similar degrees of pain or satisfaction compared to non-collapsed patients.

Keywords: *Osteonecrosis of femoral head, Kerbaul angle, necrotic index*

Sorumlu Yazar / Corresponding Author:
Dr. Selahaddin Aydemir selahaddinaydemir@gmail.com

Aydemir S.	0000-0002-4201-8239	**Türemiş C.**	0000-0002-5794-6652
Acar E.	0000-0003-0177-8343	**Hapa O.**	0000-0001-8154-658X

INTRODUCTION

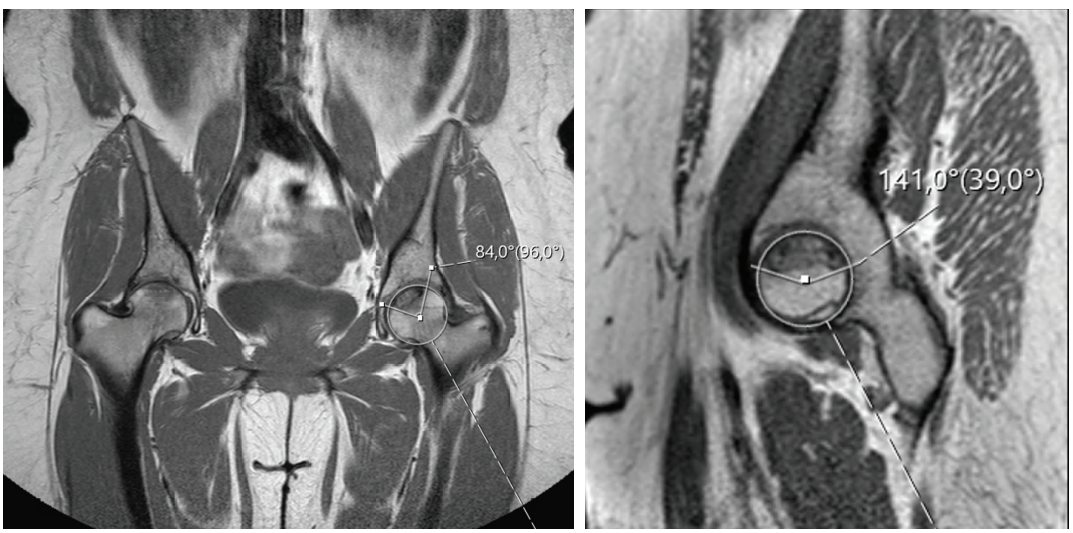
Bone marrow aspirate concentrate (BMA) enhances the efficacy of core decompression (CD) which is the most commonly used surgery in the early stages of osteonecrosis with variable results. BM aspirate efficacy is still under investigation by different techniques of culturing or expansions of cells and /or co-usage with platelet-rich plasma (1). Approximately 38% of patients receive a hip replacement at an average of 26 months after core decompression without augmentation (2). There is still limited evidence that the addition of bone marrow cells to CD result in better clinical outcomes and lower rate of worsening of the stage of the disease (3). There are also systematic reviews that support co-usage at earlier stages of the disease, and that no obvious additional benefits are reported at stages 3 and 4 (4-9) or the extent of necrosis is wider 'higher kerboul angle or necrotic index (10-11). In the early stages of osteonecrosis, sufficient repair capacity can reverse the process of osteonecrosis, and mesenchymal stem cells in the BM can potentially augment this by both differentiating into different cell lines such as osteoprogenitor cell resulting in new bone formation and/or enhancing vascularization and oxygen flow to ischemic tissues (12,13). Song et al (14). demonstrated new bone formation in the femoral head histologically six weeks after mesenchymal cell transplantation. Supporting this Tabatabaee et al (15). demonstrated improvement of MR appearance in some patients when co-injected BM with CD. BM Access and co-usage are additionally safe and easy (16).

The purpose of the present study was to compare demographic variables, extent or stage of the lesion, pain scores, smoking habit, and steroid usage between collapsed (stage IV) and noncollapsed hips. The hypothesis was that the extent and stage of the lesion would be higher at collapsed hips while VAS and satisfaction scores would be similar.

PATIENTS AND METHODS

Electronic medical records and imaging of a consecutive series of patients who were treated for AVN of the femoral head were reviewed. Patient's visual analog pain scores (VAS scale 0–10, with 10 being the worst pain) were recorded pre-and post-operatively. Satisfaction score (0 'unsatisfied'-100 points 'maximum satisfaction') were recorded. All patients had at least one year of clinical and radiographic follow-up. Exclusion criteria were represented as diabetes, rheumatoid arthritis, infections, tumours, history of femoral head/neck fracture, previous hip surgery, and patients receiving only core decompression without BM injection (n:12).

Standard plain radiographs, including the anterior-to-posterior pelvis and lateral hip views, as well as an MRI of the hip were obtained.



A-CORONAL B-SAGITTAL

Fig 1. Modified Kerbaul angle (A+B)

Ficat-arlet staging was performed preoperatively, and was followed up with pelvis radiographs (17). Patients were divided into two groups depending on the presence of total collapse of the femoral head and decreased joint space (Stage IV) identified in the latest follow-up compared to the group without collapse.

The extent of the osteonecrotic lesion was investigated with a modified MRI-based Kerboul method (18,19). The necrotic angles from the mid-coronal (A) and mid-sagittal (B) planes, with the largest diameter of the femoral head were selected for measurement. The femoral head center and necrotic angles were then measured from two planes and added to calculate the modified Kerboul angle (A+B) (Fig 1). The necrotic index was also calculated using the formula (A/180) X (B/180) X 100 (11).

A 2.5-mm threaded guidewire was placed into the osteonecrotic lesion, which was confirmed to be within 2-3 mm of the articular cartilage surface on an anterior-to-posterior and lateral fluoroscopic image of the hip, then a 5.0-mm cannulated reamer was passed along the guidewire into the lesion. Then 1cm skin incision was done over the Anterior Superior Iliac Spine. A trocar was then advanced along the table of the iliac crest. Approximately 50 mL of bone marrow was gathered into heparinized syringes. It was injected later into the necrotic area.

Patients were recommended to perform partial weight-bearing with gait aids for six weeks postoperatively.

Statistical analysis

Data analysis was performed using SPSS for Windows, version 22 (IBM, SPSS statistics). A value of $p<0.05$ was considered statistically significant. The effect of dichotomous or categorical variables were analyzed using the Fisher exact test or chi-square test. Continuous variables like were analyzed using the Mann-Whitney U test

RESULTS

There were twenty-three male patients (eight bilateral, fifteen unilateral) and seven female patients (four bilateral, three unilateral) (a total of forty-two hips). The mean age of the patients was 44±10 years. Mean follow-up was 35±18 (27-60) months. 18 hips were Ficat-Arlet stage IIA, 13 stage IIB, and 11 stage III. Eleven patients had a history of smoking, and twenty patients had a history of corticosteroid usage (two patients traumatic, rest idiopathic).

Twenty-four hips were collapsed (ficat-arlet stage IV) at the latest follow, while eighteen hips were not collapsed at the latest follow-up. Demographic variables (age, sex), follow-up time, preop VAS, postop VAS, satisfaction point, frequency of smoking, steroid usage, and FIcat—Arlet stage were not different between collapsed and noncollapsed hips ($p>0.05$). The only difference between two groups was Kerboul angle (p:0.003), and the necrotic index (p:0.03) (Table I).

Table I. Comparison between collapsed and non-collapsed hips (mo: months, *: p<0.05)

Groups	Collapsed hips (n:24)	Non-collapsed (n:18)	P value
Age	45±11	42±10	0.3
Sex	13M, 3F	10M, 4F	0.4
Follow-up (mo)	38±17	32±18	0.1
Smoking	7	4	0.5
Steroid use	10	10	0.5
Preop Ficat-Arlet stage	8 IIA, 8IIB, 8III	10 IIA, 5 IIB, 3 III	0.2
Preop VAS	8	9	0.07
Postop VAS	2	3±1	0.4
Satisfaction pt	79±9	76±11	0.5
Preop Kerboul angle	228±38*	180±54*	**0.003***
Preop Necrotic index	38±13*	29±17*	**0.03***

DISCUSSION

The main finding of the present study was the extent of the lesion was greater in collapsed patients compared to non-collapsed. Pain, satisfaction scores, demographics, possible etiologic factors, and stage of the disease did not differ between the groups.

Most of nonstromal cells in the bone marrow are white blood cells and their precursors, while the rest is red blood cells and lymphocytic cell lineage providing vascular progenitors, osteoprogenitor cells in addition to paracrine action via cytokines (20-24), and smaller studies with limited evidence advocate to use after core decompression. However, optimal ways to concentrate and deliver these cells are still under investigation (20).

Most studies reported the efficacy of adding BM aspirate at earlier stages of AVN, especially before the stage 3, where subchondral fracture is seen (4-9). Hernigou et al (7). compared the efficacy of BM addition to CD at bilateral symptomatic early stage (1 or 2) patients (one side CD, other side CD plus BM) eliminating selection bias such as standardization of procedure (cell harvest, count, surgery technique), outcome measure, etc. and reported decreases in incidences of collapse, and need for arthroplasty in long term follow-up. In the present study, although there tended to be more stage III patients in the collapsed group we could not certainly clarify it as an etiologic factor.

Another important variable is the extent of the necrosis (5). Modified Kerboul angle based on biplanar MR is easy and simple to use and predicts the subsequent risk of head collapse (19). Another study defining necrotic index, reported the extent by the ratio of necrotic angle to circle instead of the angle itself, that % 33 or lower was low risk, %34-66 medium risk, and %67-100 was high risk (11).

Boontanapibul et al (10). reported no additional benefit of BM when Modified Kerboul angle is 250^0 or above. Combination therapy resulted in with no collapse when $<200^0$ (%33 after CD alone), %12 collapsed at combined when the angle is between 200^0 -249^0 (%54 collapses at CD alone). Our non-collapsed group was within the range of this low$<200^0$ to moderate risk groups (200^0-249^0).

Another controversial issue is the rate of conversion to hip arthroplasty that radiographic correlation does not necessarily correlate with the need for total hip arthroplasty (4). Other than collapse, additional factors like synovitis, cartilage lesions, and periarticular disturbances also seem to play a role in the need for subsequent hip arthroplasty (6). Supporting this, in the present study, VAS, satisfaction scores did not differ between groups.

Age and etiologic factors could also be prognostic factors (9,25). Serong et al (25). reported that the age of 40 is a cut-off value for prognosis. They also reported trends of better survival of female hips approaching statistical significance. In the present study, the mean age was forty-four, and that collapsed hips tended to be older. Sen et al (16) reported better outcomes in the traumatic AVN group compared to the non-traumatic group possibly, due to further compromise of proliferative ability of mesenchymal cells in femoral head in non-traumatic group (16,26). Most patients in the present study had steroid usage at their anamnesis which could also result in the lower number of mesenchymal cells at the BM aspirate obtained from iliac crest (7,27).

There exist some limitations. This a retrospective study of a limited number of cases without a control group (e.g., only CD or no treatment) treated by different surgeons. Although demographic variables did not differ between groups there could have been additional factors, and co-morbidities that could have been taken into account like body mass index or underlying diseases. Second, the number of progenitor cells was not counted, location of the lesion was not reported. Postoperative MR imaging was not done to assess the degree of healing. Last, there is a lack of evidence of fate and /or tract of the injected cells.

To conclude, BM aspirate injection, in addition to CD, provided pain relief and postoperative satisfaction in our patient group. The collapse or progress of disease mainly depends on the extent of the disease rather than demographic or etiologic factors, while collapsed patients report similar degrees of pain or satisfaction compared to non-collapsed patients.

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