Early Stages Non-Traumatic Avascular Necrosis of Femoral Head Treated by Core Decompression With and Without Platelets Rich Plasma Injection: A Comparative Study

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Abstract- Core decompression is one of the commonest used techniques in the handling of osteonecrosis of the pre-collapsed head of the femur. Core decompression had succeeded in preserving the hip joint and delaying the requisite for total hip replacement, but it had failed in the induction of osteogenesis in the necrotic area, thus augmenting core decompression with biological agents to induce osteogenic activity. To assess the effects of platelet-rich plasma in non-traumatic avascular necrosis of the hip joint (early stage) after core decompression. Interventional comparative study for twenty-four patients (32 hip joints) with AVN of the head of the femur was involved in this prospective study, and they were separated into two groups of 16 hips, group (A) treated by core decompression and PRP injection and group (B) treated by core decompression alone. There was a significant statistical difference in Harris Hip Score and Visual Analogue of the two groups at six months follow up (P<0.05), but this difference was insignificant statistically at 12 months follow up. The radiological success was better in the group (A) as compared to group (B) (13 of 16 versus 10 of 16 hips). The addition of PRP to core decompression for pre-distorted stages of the head of the femur had resulted in improved pain alleviation and functional results and had slowed the disease progression in the one year of follow up.

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Keywords: Avascular necrosis; Platelet-rich plasma (PRP); Head of the femur

Introduction

Avascular necrosis (AVN) of the head of the femur head is a progressive illness resulted from a serious decrease in the femoral head blood supply and raises the intraosseous pressure, which may end in cellular death, crack, and failure of the articular surface (1).

It classically involves active young persons (between 20 to 40 years), with the male's predominant male: female ratio 3:1. About 10% of the 250000 total hip replacements done yearly in the United States are due to AVN (1-4). Very few femoral heads with avascular necrosis resolve spontaneously; 85% of symptomatic and 2/3 of asymptomatic patients will develop to femoral head distortion (1,2,5). Once femoral heads with osteonecrosis progressed to collapse, most of them will be successfully treated by THA (2,3).

Core decompression is one of the usual techniques to preserve the joint, chiefly in pre-collapse phases, but its usefulness is still debated (6-8). because this procedure alone does not prompt satisfactory osteogenic activity in the necrotic region. The improvement of regenerative medicine in current years has gone further than this limit, where core decompression was augmented with added measures like an osteoinductive agent that can boost bone repair (7,9). Platelet-rich-plasma (PRP), which is a fraction take out by the centrifugation of whole blood, plays a vital role in tissue repair, regeneration, and differentiation (6). It contains various growth factors and also positive effects on the encouragement of bones, blood vessels, and the creation of chondrocytes (10).

Plain X-rays, although not particularly distinguishing early- stages osteonecrosis, are, in general, the first imaging modality used, and they should be ordered in AP and frog-leg lateral views (1,2), Figure 1.

MRI is the usual imaging investigation for the pre-collapse phases of AVN. An initial osteonecrotic lesion appears as a single-density line on the T1 pictures,

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characteristically in the anterosuperior region of the femoral head, while T2 I in mages the picture of a double line sign notice. The other hip also must be studied because of ¾ of the cases existing bilaterally (1,2,11), Figure 2.

Many classifications for AVN, mainly the Ficat and Arlet, and the Steinberg University of Pennsylvania systems (1,12)

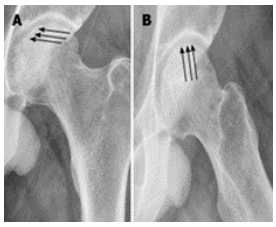

Figure 1. AP and cross leg lateral X-rays viewing (arrows) the crescent sign (1)

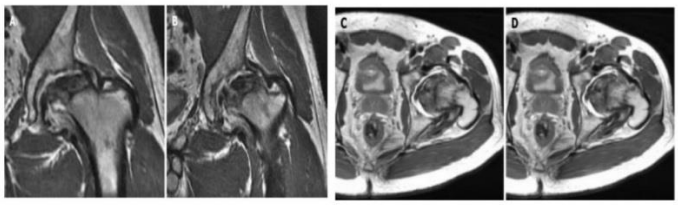

Figure 2. MRI of the left hip (1)

Materials and Methods

An interventional comparative study conducted in the orthopedics section of Al-Kindy Teaching Hospital/Baghdad city/Iraq, from January 2018 to January 2019 and followed up for 12 months postoperatively.

Twenty four patients (32 hip joints) with AVN of the head of the femur were involved in this study. The inclusion criteria were: age between 20-50 years, Ficat and Arlet stage I, IIA and IIB, and non-traumatic causes of AVN, while the exclusion criteria were patients with blood dyscrasias, patients who received chemotherapy and medications that decrease bone marrow function, and platelet count <175,000/µL and hemoglobin <11 g/dl.

A proper history, thorough physical examination, laboratory and radiological studies were made to determine the diagnosis, stage, and cause of AVN and the eligibility of the patients. After meeting the inclusion criteria, patients were separated into two groups: group (A): involved 16 hips managed by core decompression and PRP injection, and group (B): involved 16 hips managed by core decompression alone. The patients follow up for one year using the Harris Hip Score (HHS) (13) and Visual Analogue Scale (VAS) pain (14), before surgery, six months, and 12 months.

An informed agreement was gained from all patients.

All patients subjected to core decompression after proper anesthesia in supine positioning, lateral incision to the upper femur and using a guidewire inserted anteriorly parallel to the neck of the femur and drilling by using a 4.5 mm drill inserted under fluoroscopic control to penetrate the femoral cortex laterally at the lesser trochanter level through the neck to reach the subchondral bone as far as possible Figure 3. Then a wider drill of 8 mm was used to enlarge the drilled track. Additionally, we injected the activated PRP for group A only which was prepare prior surgery via a 10 ml syringe in the drilling track with spinal needle gauge 22 and then the opening is closed by soft tissue plug. Closure of the incisions was done in layers. The patient was instructed to be kept on six weeks off weight bear to avoid collapse.

Statistical analysis

Data were collected and analyzed using Statistical Package for Social Sciences (SPSS) version 24. Descriptive statistics were represented as incidences and proportions (%). *P* below 0.05 was considered significant.

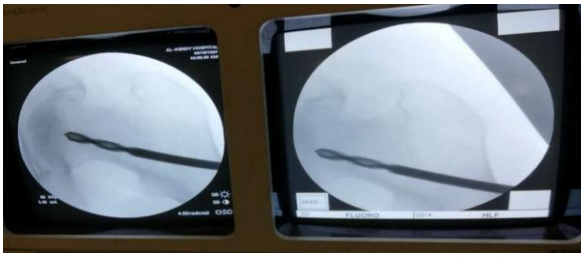

Figure 3. Entry point through the neck and head of the femur

Results

The mean age was 34.6-year-old (between 22-46 years). The males constituted the majority of the patients (66.6%).

The highest proportion of hips were in stage IIA, while the least was in stage I. (Table 1).

Table 1. Distribution of hips according to Ficat and Arlet staging

Stage	Group A		Group B	
	No	%	No	%
I	3	18.8	4	25
IIA	7	43.7	6	37.5
IIB	6	37.5	6	37.5
Total	16	100	16	100

The pre-op HHS was almost similar in both groups but at six months follow up, group (A) reported significantly higher HHS points (P<0.05) and insignificantly higher HHS points (P>0.05) at final follow up than group (B) Table 2.

Table 2. Comparison of HHS

Mean HHS points	Group A		Group B		*P*
	Mean	SD	Mean	SD	
Mean Pre-op HHS	52.4	8.0	53.0	10.4	0.85
Mean 6 months HHS	90.1	5.6	82.5	7.2	0.001
Mean Final HHS	82.3	8.9	77.5	8.9	0.14

Regarding the VAS for both groups reported almost similar scores pre-operatively. At six months follow up, group (A) reported significantly lower VAS scores (P<0.05) than group (B), and at final follow up, group (A) also reported lower VAS scores than group (B), but it was statistically non-significant (P>0.05) Table 3.

Table 3. Comparison of VAS scores

Mean VAS scores	Group A		Group B		*P*
	Mean	SD	Mean	SD	
Mean Pre-op VAS	7.2	1.0	7.1	1.0	0.73
Mean 6 months VAS	2.5	0.7	4.0	1.0	0.001
Mean Final VAS	3.9	1.2	4.9	1.5	0.06

The radiological success was better in group (A) comparing to group (B) (81.2% versus 62.5%), while there was no much alteration in clinical success rates of both groups, as shown in Table 4.

Table 4. Comparison of radiological and clinical success

Variable	Group A	Group B	*P*
Radiological success	13 (81.2%)	10 (62.5%)	0.4
Clinical success	14 (87.5%)	13 (81.2%)	1

Discussion

In this study, the mean age of our sample was 34.6 years old, and the majority of them were males; these results were similar to other Iraqi studies (15,16) and international studies (10,17).

Patients with Stage I AVN was the least proportion of patients included in this study; the same observation was reported by other studies. (16-19) this could be due to the late presentation of patients to orthopedics units or failure in diagnosis.

HHS was used to assess the functional outcome, while VAS was used to assess hip pain. In both groups, both scores were significantly associated with AVN stage (P<0.05), where better results (higher points for HHS and lower scores for VAS) at 6 and 12 months follow up were reported in patients with low AVN stage. These results are similar to Samy's (2016) (10) and Salem *et al*., (2016) (18) results. This indicates that treating AVN in the earlier stages can lead to better outcomes.

In this study, there was also an association between HHS and VAS scores and timeline; both scores are better at six months to follow up than the scores at 12 months postoperatively in both groups, which are similar to the study by Chung *et al*., (2017) (17). These findings could be explained by the effect of core decompression in pain alleviation by relieving intraosseous pressure shortly after surgery.

The improvement in pain and function in the group (A) was better than in group (B) and significant statistically (P<0.05) at six months follow up (2.5 versus 4.0 for VAS and 90.1 versus 82.5 for HHS), while at the final follow up, although group (A) hips had superior, they were non-significant statistically (P>0.05). This indicates that adding PRP to conventional core decompression procedure produces better pain alleviation and functional outcome, and this improvement was experienced by patients at the maximum level in the short term follow up. This result parallels to study of Aggarwal *et al*., (2018) (20) and Patel *et al*., (2015) (21).

The radiological and clinical success rates were greater in low staged AVN hips of both groups. This result agrees with Kraidi *et al*., (2014) (15), AL-Edanny (2012) (16), Chung *et al.,* (2017) (17), and Aigner *et al.*, (2002) (22) studies who had also reported higher radiological success rates in lower staged hips. Kraidi *et al.*, (2014) (15) and Shah *et al*., (2015) (23) had also found that the clinical success rates of their studied groups were higher in hips with low AVN stage. This indicates that treating AVN in earlier stages can prevent or decrease the development of the disease and lead to better clinical outcomes.

In group (A) hips, 13 out of 16 hips (81.2%) showed no radiological progression in the AVN stage, which was higher in number than group (B), 10 out of 16 hips (62.4%). These results agree with Aggarwal *et al.,* (2018) 20 and Houdek *et al*., (2018) (24) results.

There is no much change in clinical success rates of both groups were (87.5%) for the group (A) and (81.2%) in the group (B) in pre-operative HHS at final follow up, this apposite to study of Chung *et al.,* (2017) (17) in which the success rates were lower than the present study. This indicates that adding PRP to the core decompression procedure can delay disease progression.

The group who were treated with PRP injection with core decompression had reported better effects in pain alleviation and functional outcomes than the patients treated with core decompression alone.

The enhancement in pain and function in the PRP group was perceived at the maximum level in the short period follow up (6 months postoperatively).

There was no change in the clinical success rates of both groups.

The excellent outcome was observed in low staged hips.

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