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Case Report

Monocyte-Rich Platelet-Rich Plasma for Osteonecrosis of the Femoral Head

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Abstract

Osteonecrosis of the femoral head remains a relatively common pathology. Bone ischemia by vascularization disorder is the most recognized mechanism. All the therapies that aimed to restore an optimal revascularization have so far failed to produce satisfactory results.

The subchondral dissection is the most serious complication, synonymous for all the authors of an inevitable evolution to a depression of the sequestrum resulting in osteoarthritis with articular destruction. However, dissection may allow the angiogenic factors present in the joint space to reach the necrotic zone. We report the case of a 32-year-old adult with unilateral stage III osteonecrosis. After failure of core decompression. The patient was treated with intra-articular platelet-rich plasma with a follow-up of 1 year and 8 months. The final MRI shows a decrease in the size of the necrosis and the CT shows a consolidation of the subchondral fracture.

Keywords: *Monocyte-rich Platelet-Rich Plasma; Osteonecrosis of the Femoral Head*

Introduction

Osteonecrosis of the femoral head is a relatively common bone disorder that mainly affects young adults. Osteonecrosis occurs as a result of bone ischemia with decreased osteogenic bone marrow activity due to vascularization disorders. Until this day, all therapeutic approaches to restore optimal revascularization remain disappointing.

Spontaneous regression of osteonecrosis is rare, if not impossible. The appearance of the fracture during evolution is a crucial point, leading to the loss of joint congruence and osteoarthritis of the hip.

The condition is often asymptomatic. Inaugural acute hip pain or during evolution, often corresponds to a collapse of bone sequestration.

MRI allows early diagnosis of the disease even before the appearance of radiographic signs. CT remains the most sensitive examination in follow-up to search subchondral dissection.

All classification (ARCO, Ficat...) agree to assign stage III to the appearance of subchondral fracture. We can distinguish:

- Stages I and II (early stages) where conservative treatment may be attempted.
- Stages III and IV (Delayed Stages) in which joint preservation options are less effective.

Core decompression is widely used in stages I and II of the disease. All authors admit that beyond stage III, the gesture retains limited effectiveness in the short and long term. Prosthetic surgery is reserved for advanced stages of collapse and hip osteoarthritis.

Case Presentation

32 year old patient, with no particular history. Consult for osteonecrosis stage III of the femoral head.

The patient received a core decompression on 21/05/2018.

MRI after core decompression 07/06/2018 compared to the initial MRI 01/04/2018 finds:

- An increase in the size of the necrosis going from 40 mm to 44 mm.
- Fibrous type signal from the necrotic area.
- Interruption of the subchondral bone plate.
- Discreet loss of sphericity of the head.
- Edema of the neck and part of the head.
- Gadolinium injection: sub-lesional vascularization and absence of vascularization of the necrosis zone.

First session 16/09/2018:

- Injection of 5 ml of Prolotherapy (25% dextrose) in intra-articular under ultrasound guidance.
- 1 week after, Injection of 5 ml of PRP then 5 ml of ozone at 20 µg/ml intra-articular under ultrasound guidance.

Leukocyte-Rich Platelet-Rich Plasma was prepared from 20 ml of the patient's venous blood by centrifugation at 400g for 10 minutes taking the buffy coat and a part of the plasma.

Second session 02/03/19

- Injection of 5 ml of Prolo therapy (25% dextrose) in intra-articular under ultrasound guidance.
- 1 week after, Injection of 5 ml of PRP then 5 ml of ozone at 20 µg/ml intra-articular under ultrasound guidance.

Monocyte-Rich Platelet-Rich Plasma was prepared from 30 ml of the patient's venous blood by density gradient centrifugation using Lymphoprep (Axis Shield) according to the manufacturer's instructions.

Third session 03/08/19

- Injection of 5 ml of Prolotherapy (25% dextrose) then 5 ml of PRP and then 5 ml of ozone at 20 µg/ml intra-articular under ultrasound guidance.

Monocyte-Rich Platelet-Rich Plasma was prepared from 30 ml of the patient's venous blood by density gradient centrifugation using Lymphoprep (Axis Shield) according to the manufacturer's instructions.

Evolutionary monitoring

MRI

- Decrease in edema.
- Gadolinium injection: Partial revascularization of the necrotic territory gradually increasing after each session.
- Fibrous signal of the necrotic zone unchanged during evolution.
- Decrease in the size of the necrosis goes from 44 cm on 07/06/2018 to 33 cm on 18/11/2019.

Scan

- Absence of consolidation after the 2nd session 29/06/2019.
- Full consolidation after the 3rd session 18/11/2019.
- There is a notch in the femoral head on the core decompression path unchanged.

Scintigraphy

- 30/11/2019.
- Focus of hyperfixation on the femoral head, evidence of the presence of osteoblastic activity.
- Lack of fixation at the acetabulum in favor of the absence of signs of osteoarthritis.

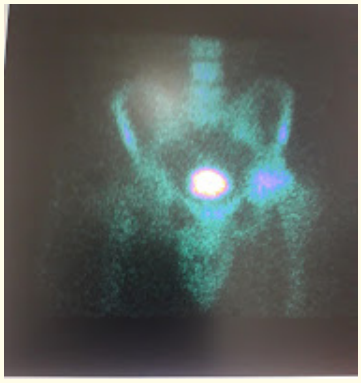


Figure 1

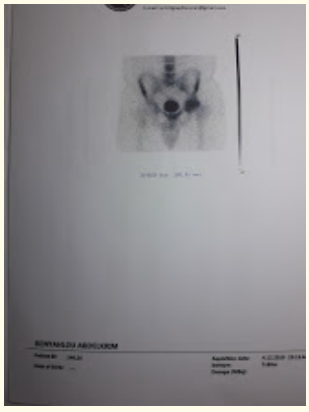
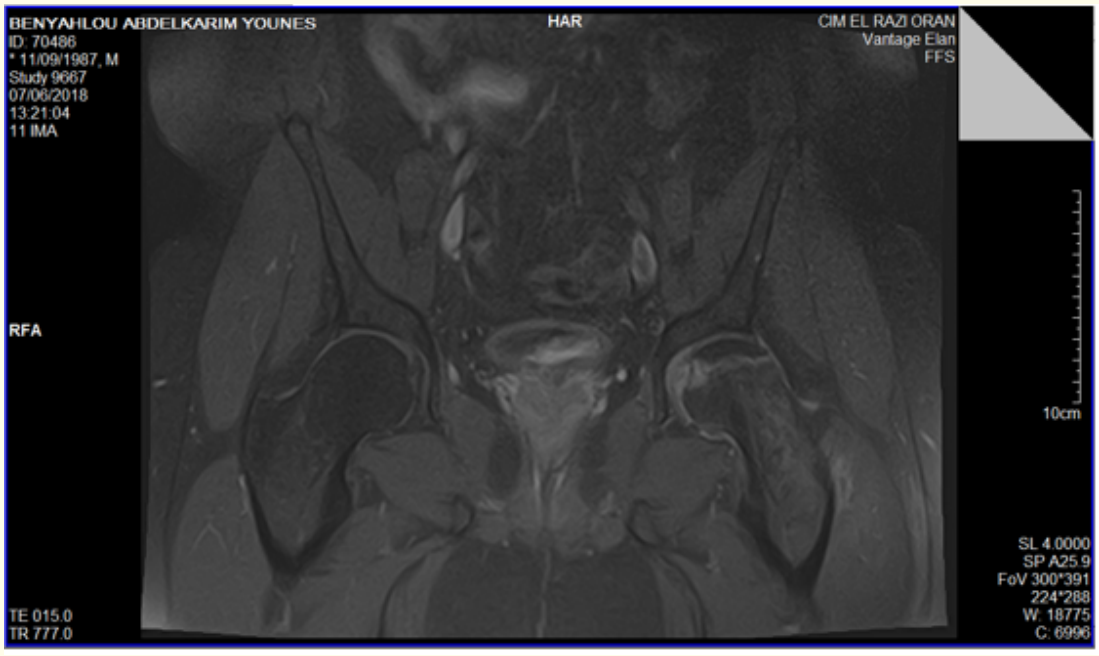
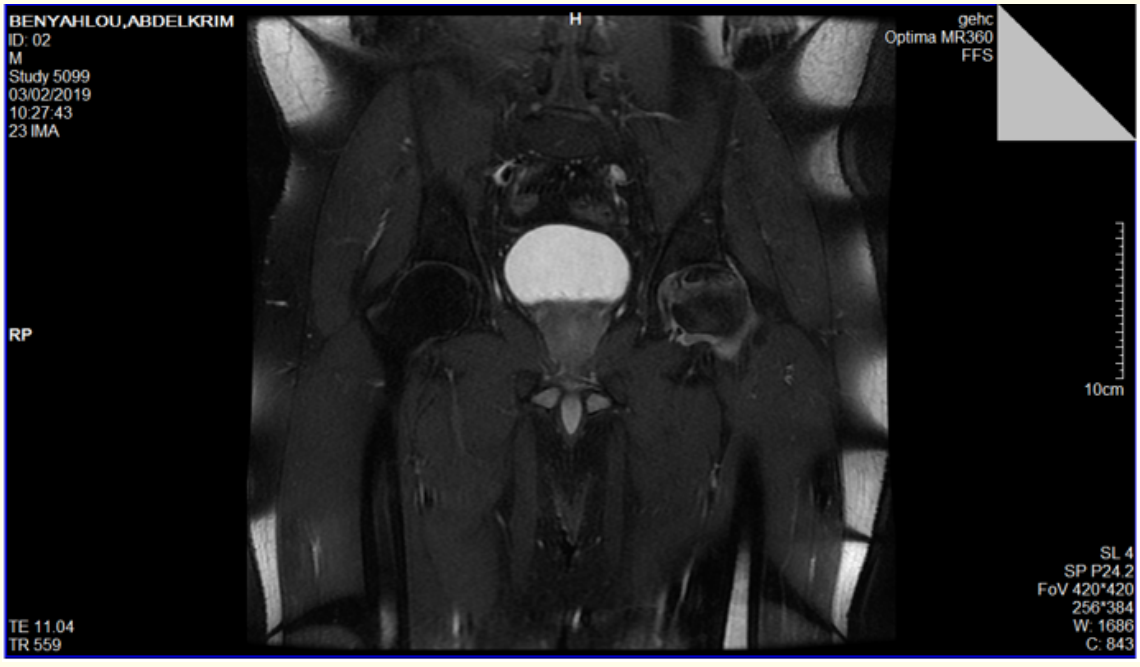


Figure 2

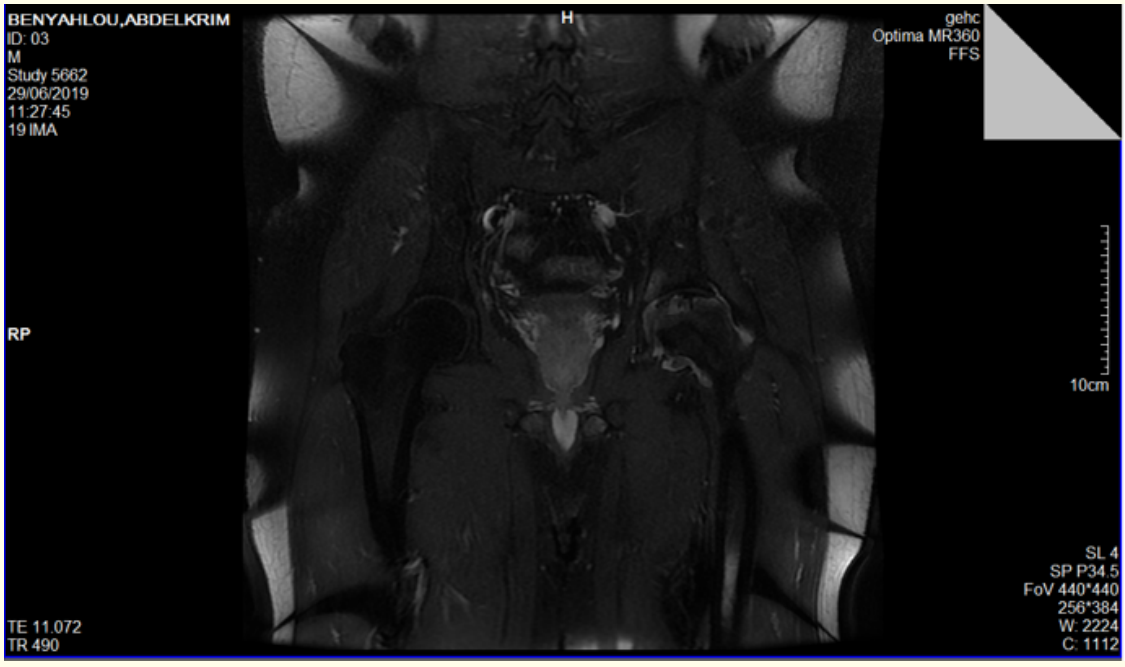
MRI Gadolinuim Injection



After Core decompression



After 1st session of PRP.



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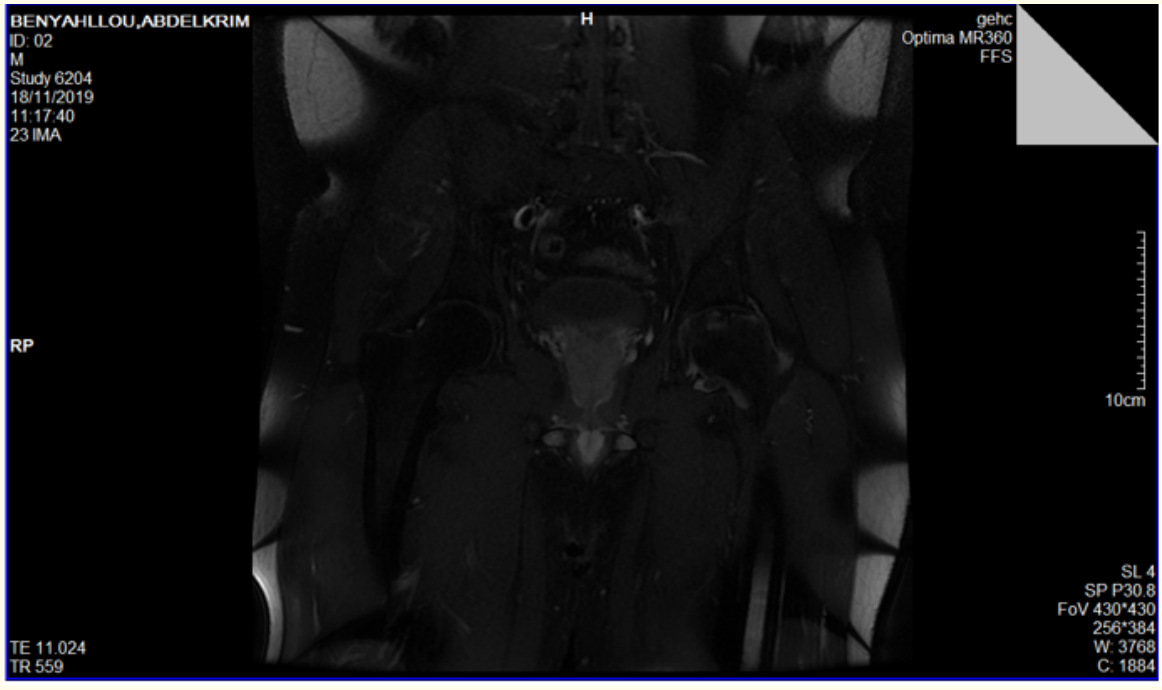
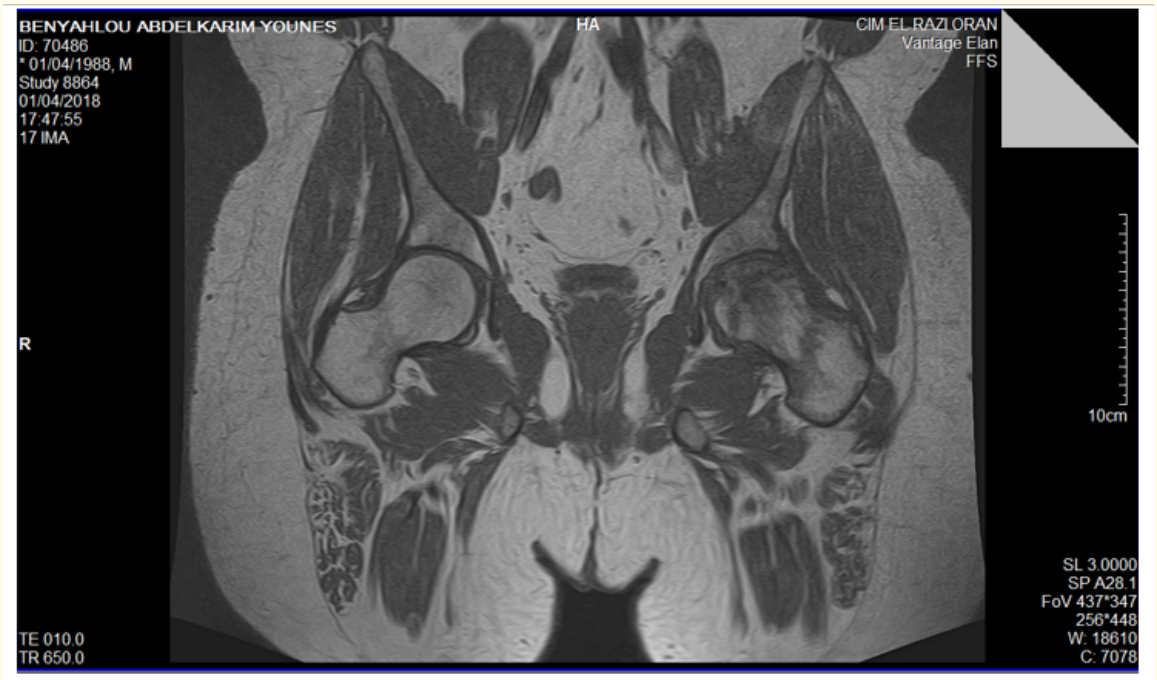
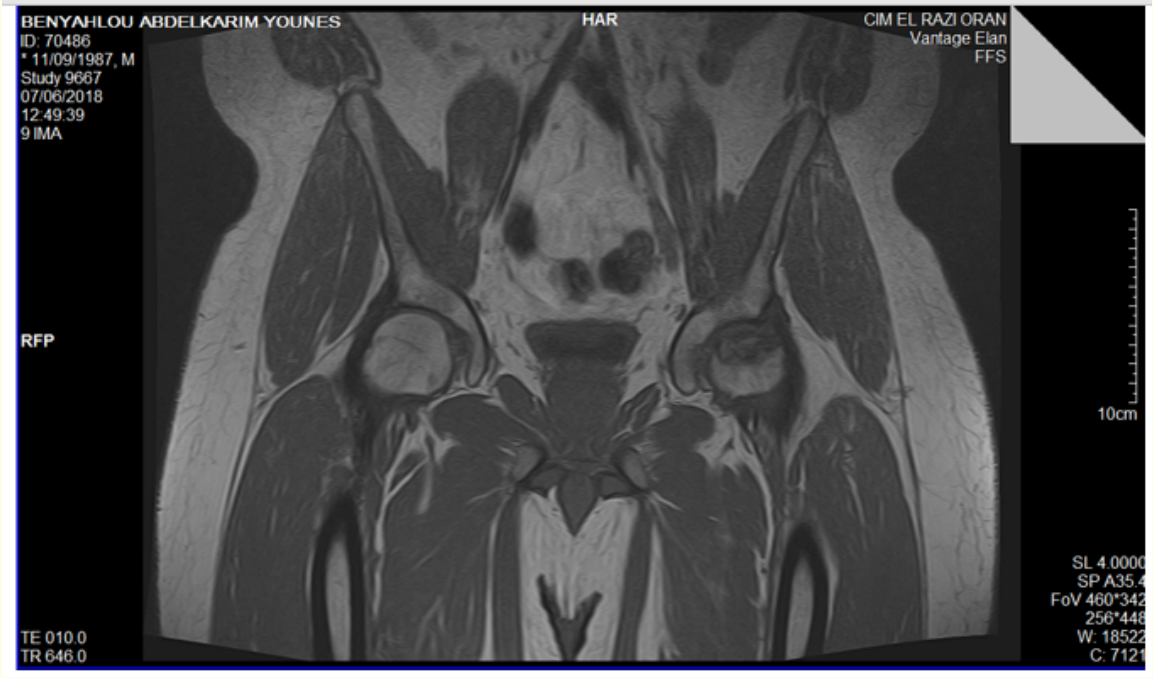


After the 3rd session of PRP.

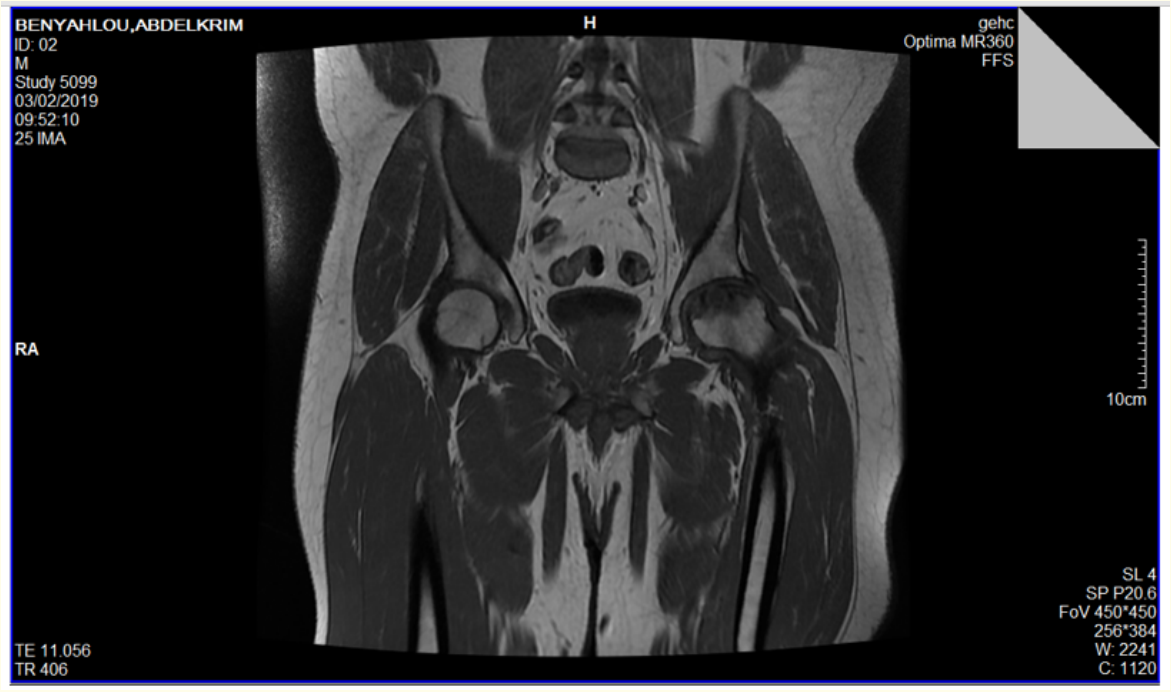
MRI T2 evolution



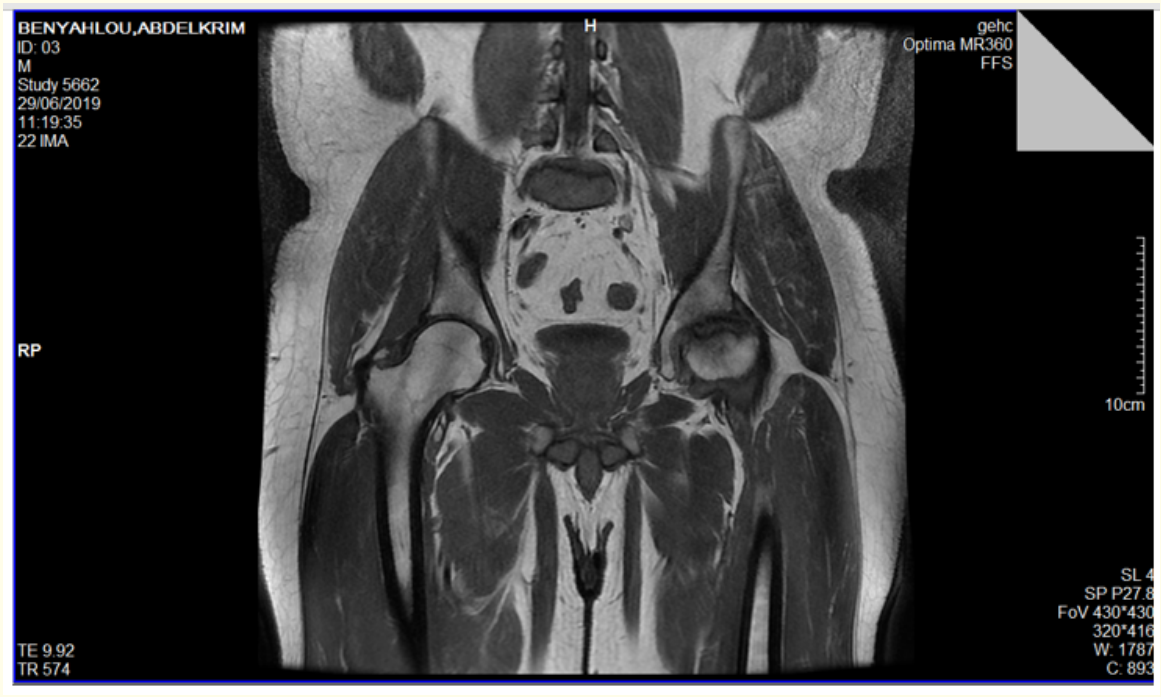
Before core decompression.



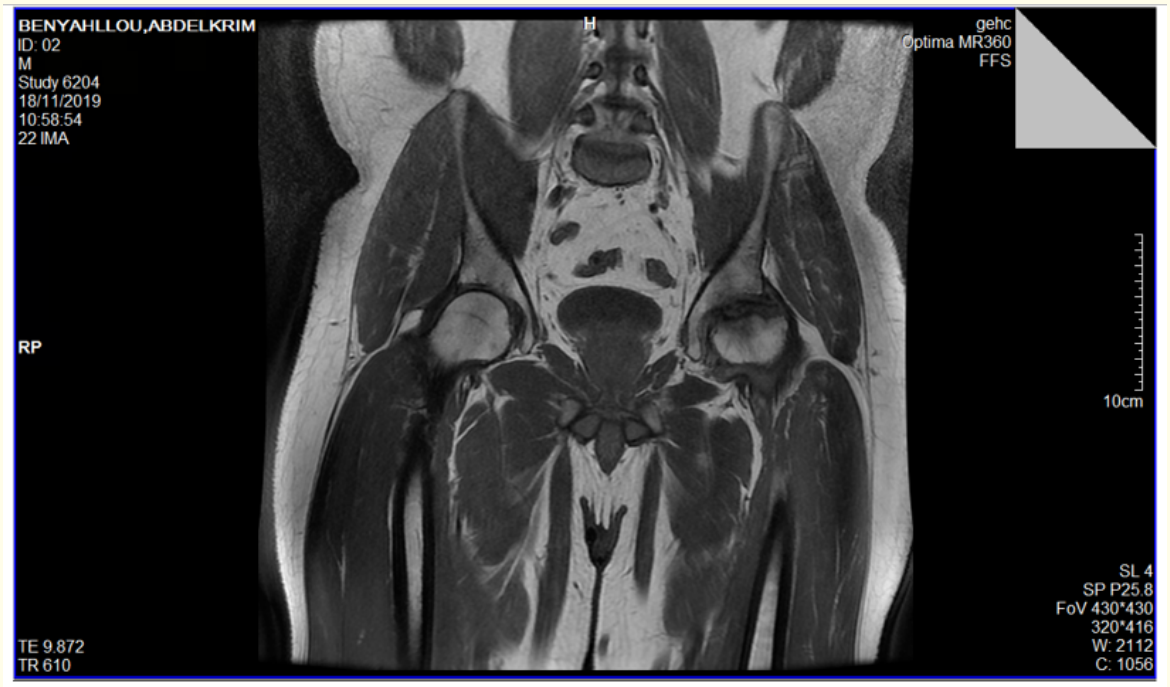
After core decompression.



After 1st session.

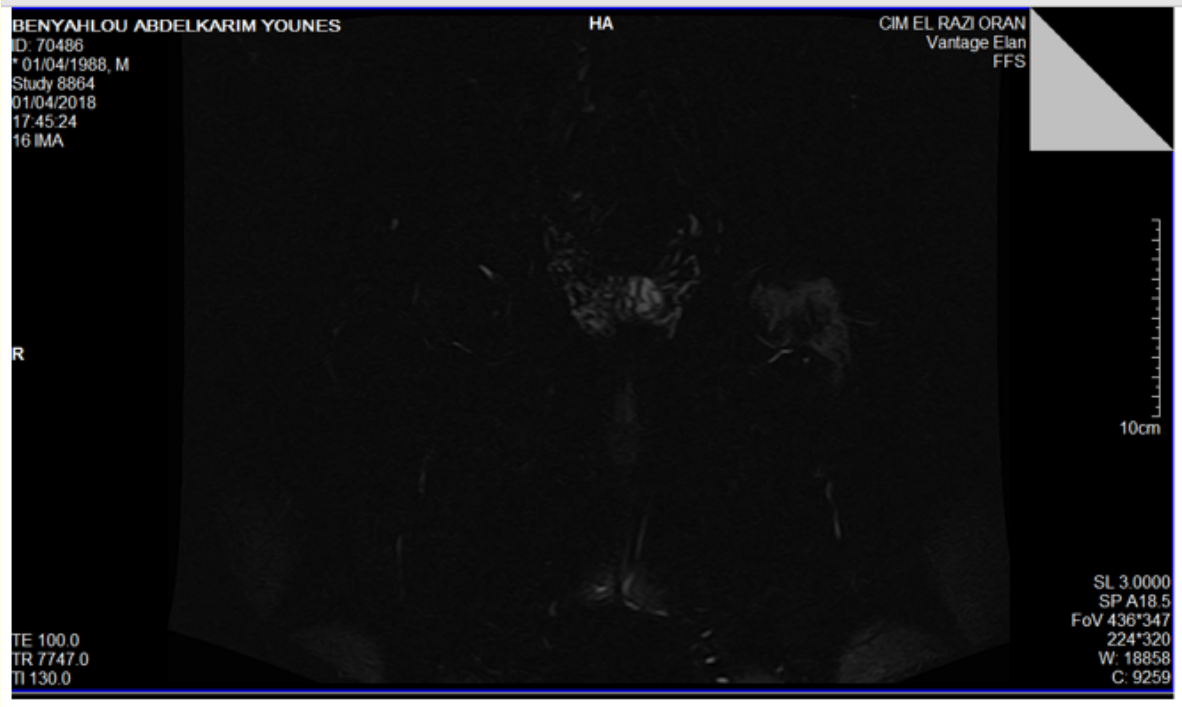


After 2nd session.



After 3rd session.

MRI Proton density EVOLUTION



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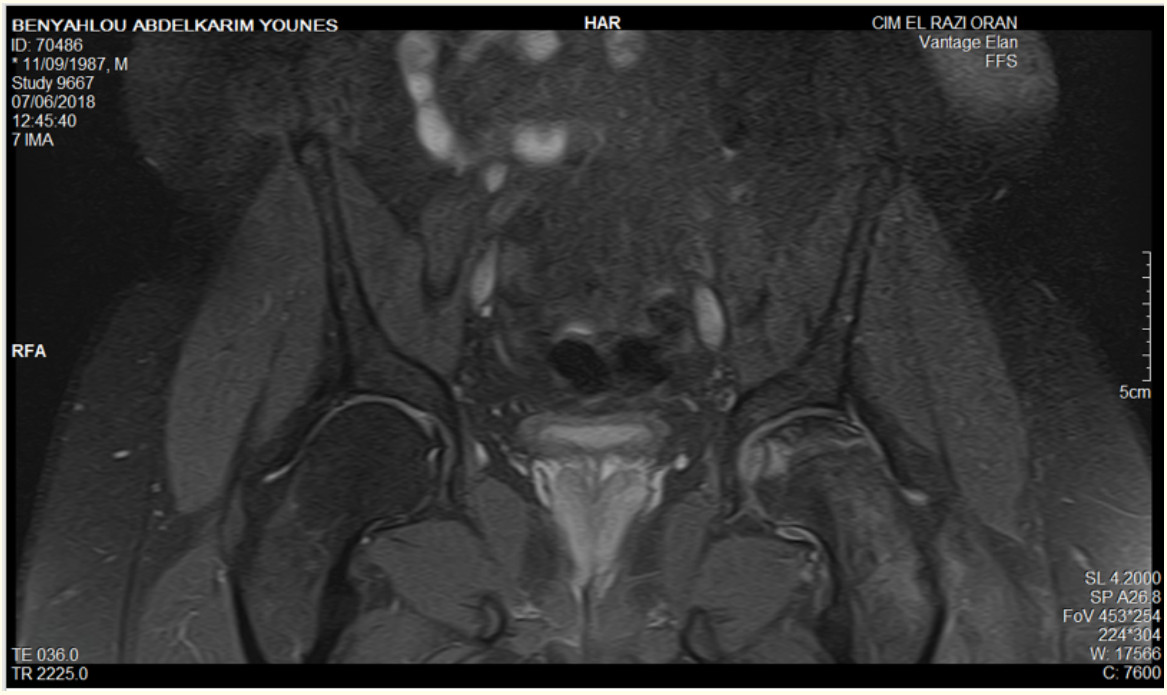
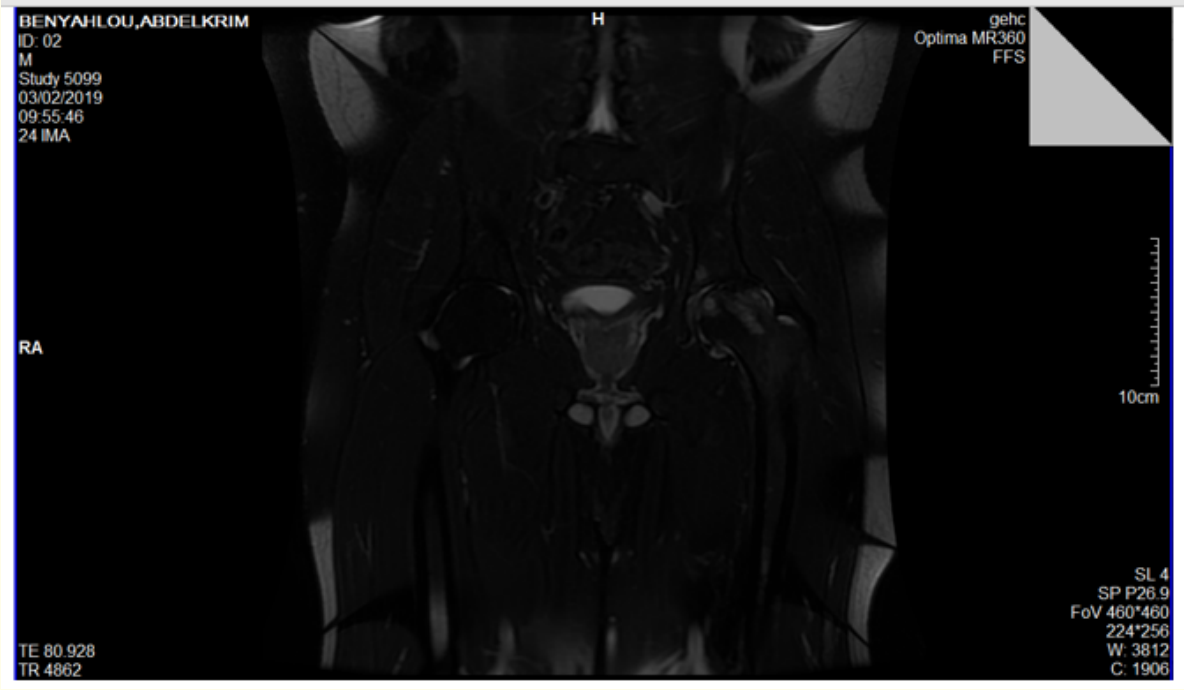
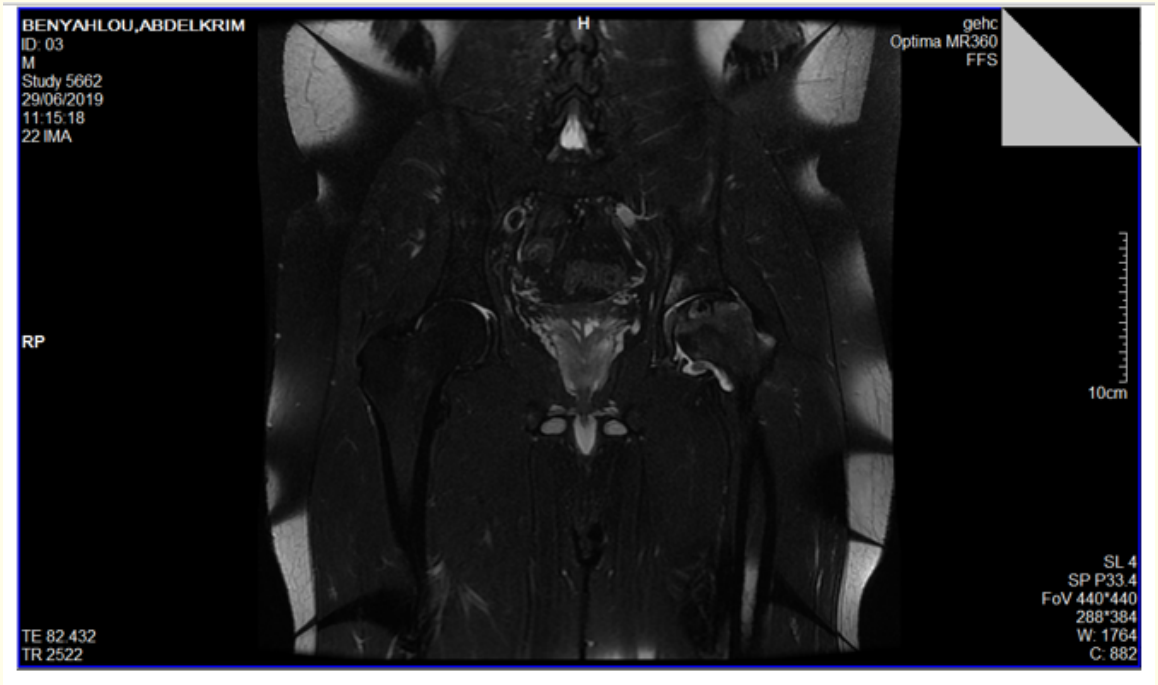


After core decompression.



After the first session of PRP.



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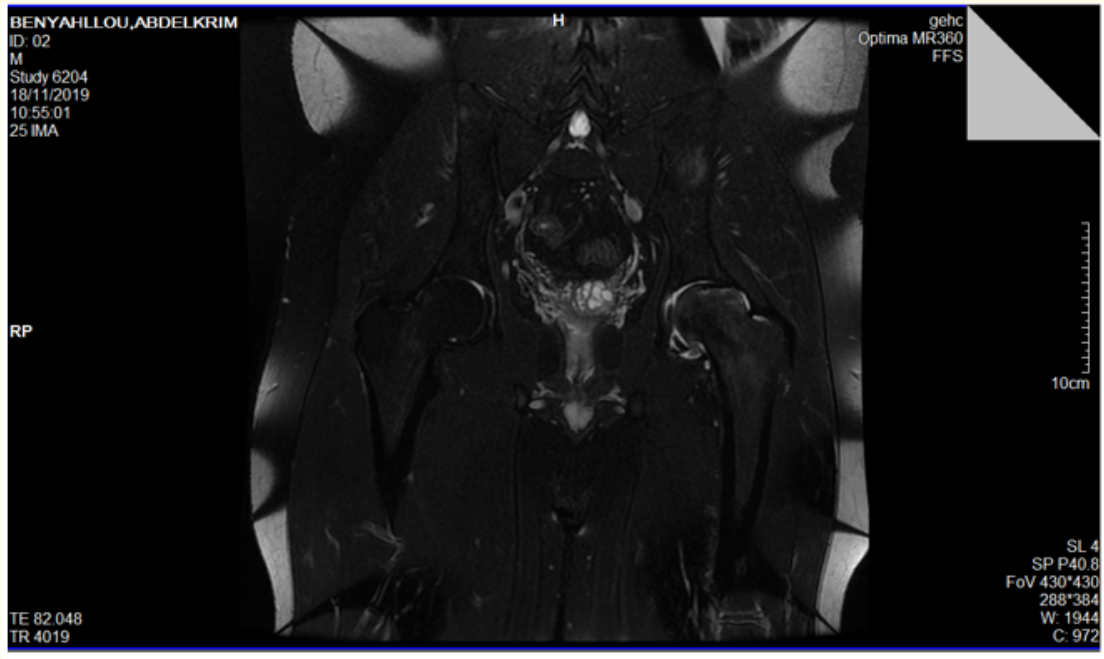
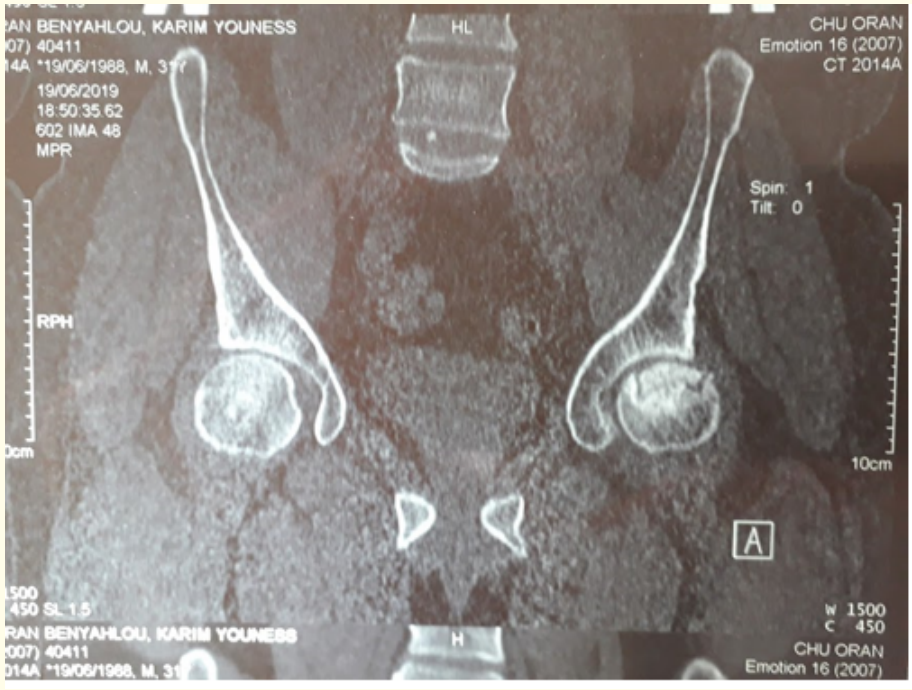


After the 3rd session of PRP.

CT Scan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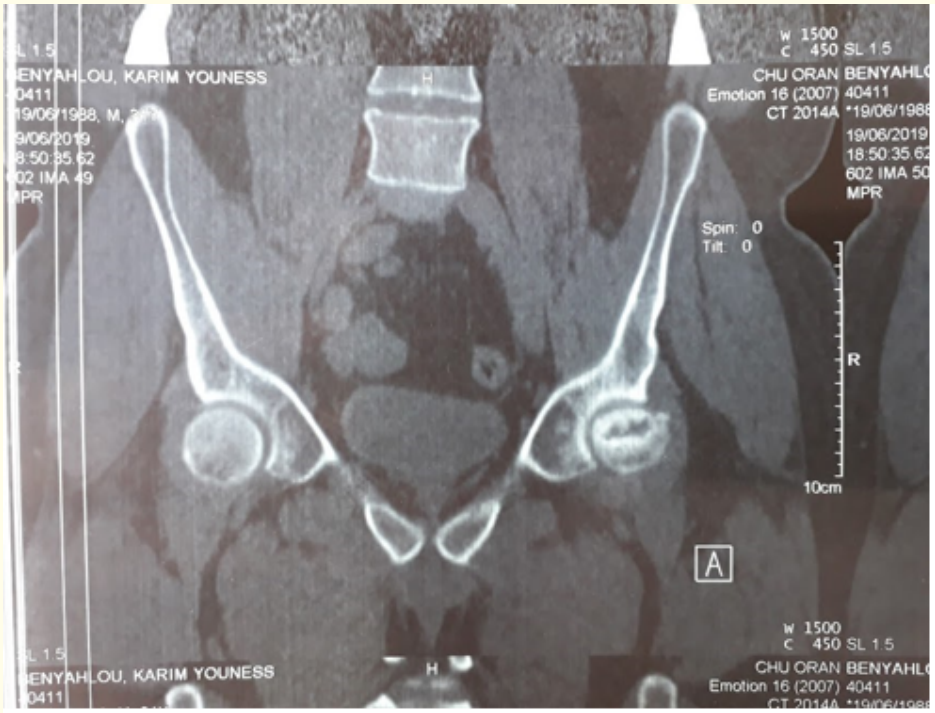
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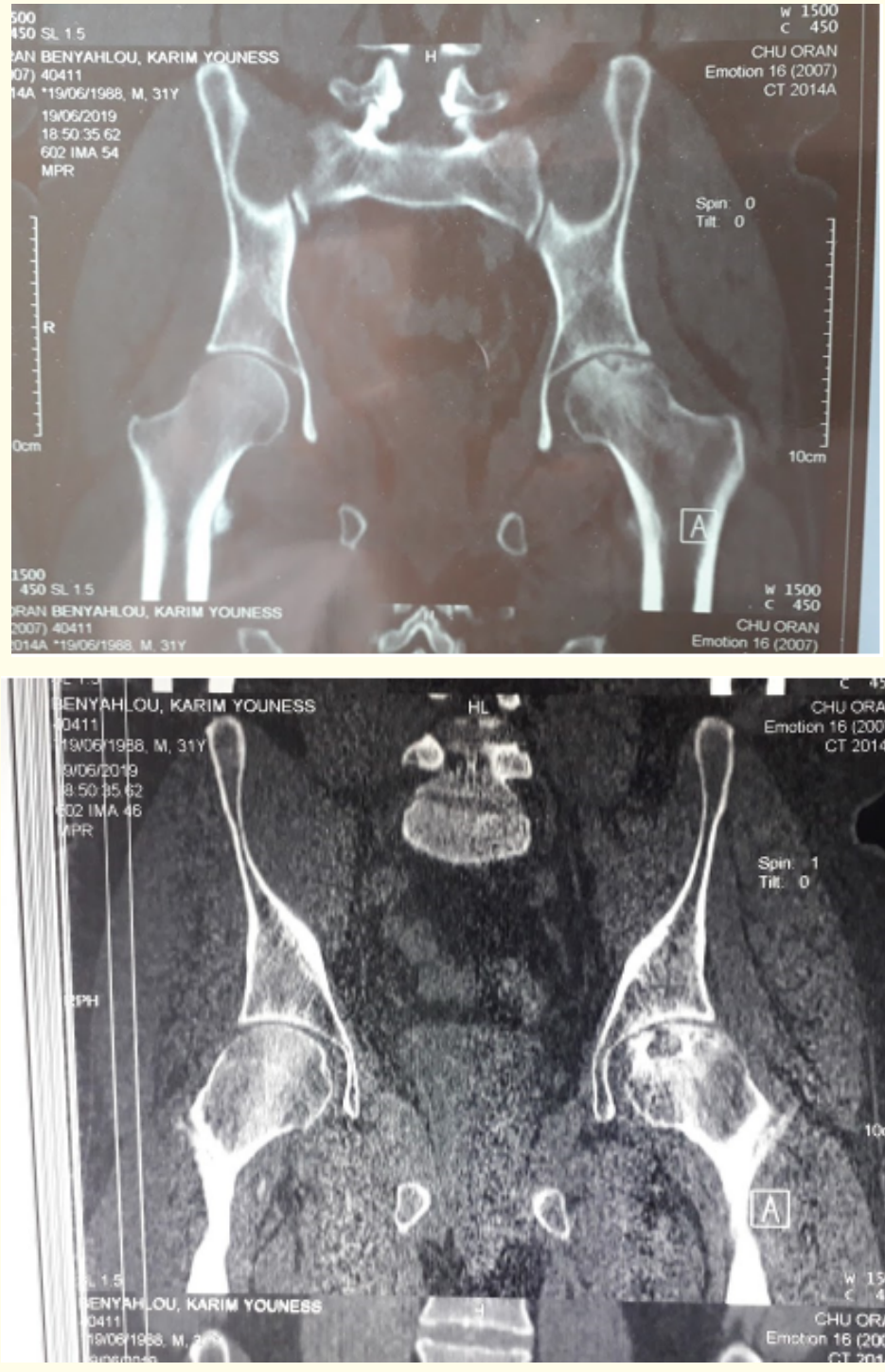

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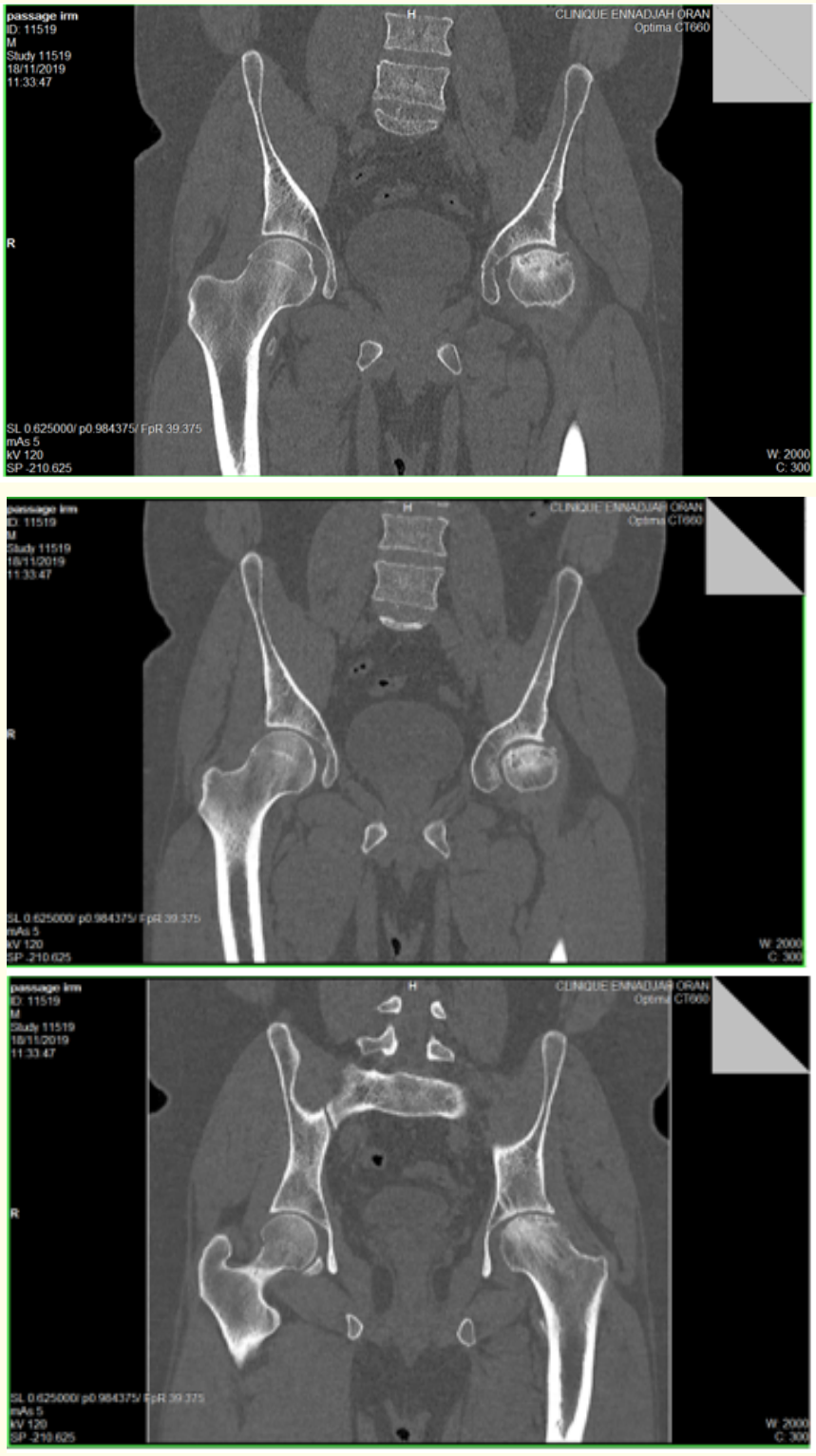
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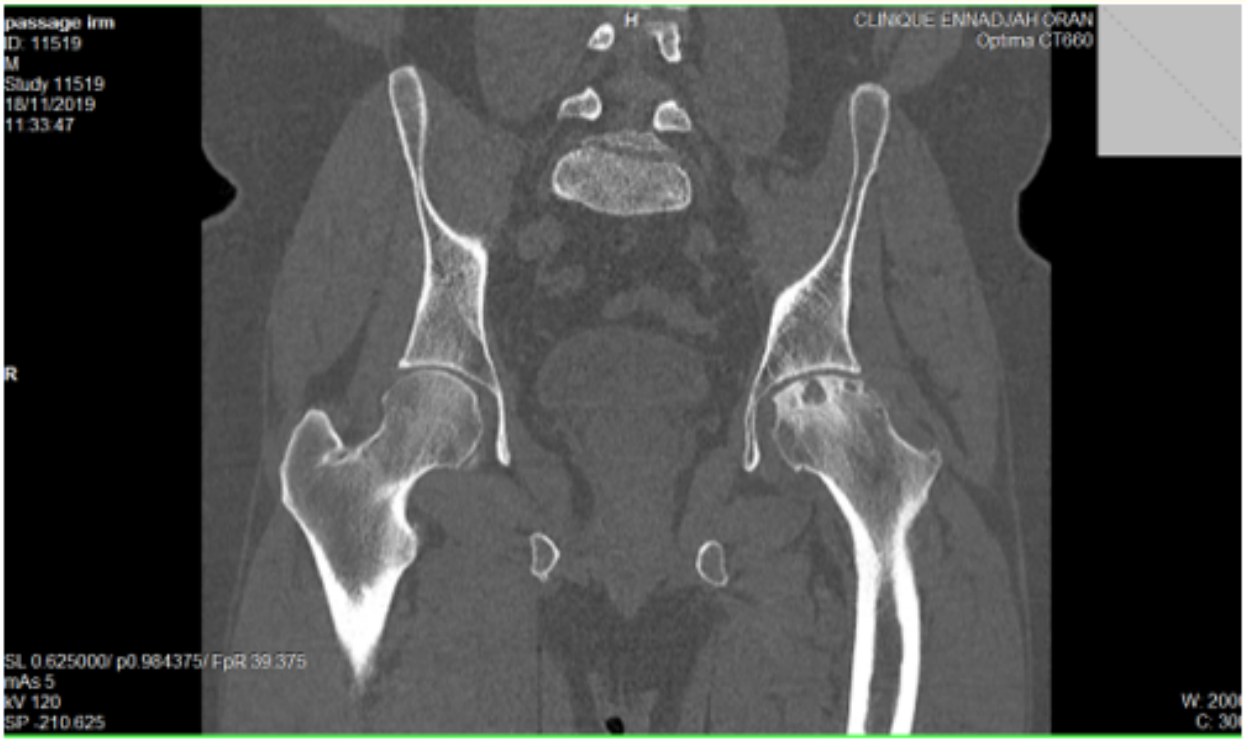

After 3rd session of PRP.

Discussion

In osteonecrosis, various repair processes can be observed during evolution: Dominant resorption of the necrotic bone, which leads to the collapse of the necrotic zone, Repair limited to the separation interface Or, extension of the repair process in the necrotic zone [1].

MRI monitoring of the evolution of the necrotic zone allows us to find: Initially class A (fat like) MR appearance. During evolution, It can become class B blood like signal, then class C (fluid like) and finally class D (fibrous like) [2,3]. In MRI, intra-articular effusion and edema in the residual head and neck region are indirect signs of adverse evolution [4].

MRI seems to distinguish only limited repair. Because the process of destruction and repair seem to have a similar signal in MRI, in particular, in the reactive separation interface. Contrast enhanced MRI can be used to predict the evolution [5]. Advances in scintigraphy, currently allow to suspect the occurrence of the fracture, showing in stages II and IIIA, a maximum absorption number in the lateral region of the femoral head, corresponding to the point of initiation of the detachment. While in stage I, the maximum absorption number is seen in the anterior region of the femoral head [6].

The subchondral fracture and fibrocartilaginous callus are described as signs of unfavorable evolution towards joint destruction. However, the fracture could facilitate the process of repairing osteonecrosis. The macroangiographic and histological studies of the necrotic femoral head find a hyper vascular focus consisting of proliferation of repairing arterioles more and more widespread in the advanced stages. Secondary, osteoarthritis also becomes a source of inflammatory mediators and free angiogenic factors in the joint space which penetrate the necrotic zone through the fracture [1,4].

The use of cell therapy in osteonecrosis has already been started as a research program in 1985, particularly the injection of stem cells [7,8].

The PRP, obtained from a simple blood test, was developed with the aim of stimulating the different phases of tissue repair. Studies show that platelets possess angiogenic properties in vitro and in vivo and elucidate some of the signaling mechanism responsible for these effects [9,10]. Platelet concentrates, however, remain variable. Because a large number of platelets are in the leuco-platelet band located at the top of the erythrocyte layer [11].

Density gradient centrifugation gives a very high recovery of platelets and monocytes in excellent functional with minimal contamination by other cells [11,12]. Monocytes which have a known role of protecting and defending the organism against bacteria, foreign substances and tumor cells are also distinguished by an angiogenic action. Numerous studies have reported that osteoclasts (OCs) can be generated from granulocyte macrophages forming pro-spawning colonies as well as from the PBMC population [13,14].

Medical Ozone (O_2-O_3) appears to behave as a bioregulator when it comes to contact with a biological fluid, releasing factors from human endothelial cells and normalizing cellular redox balance [15].

In osteonecrosis, the PRP has already been used as a complementary agent in the therapeutic arsenal [16].

In this presentation, we report the case of a patient with osteonecrosis of the femoral head stage III treated with Platelet Rich Plasma. The final radiological assessment finds a consolidation of the subchondral fracture, with reduction of the size of the necrosis and improvement of the clinical symptomatology.

Leukocyte-Poor Platelet-Rich Plasma can significantly improve pain in post therapy, but does-it have a better result. The presence of red blood cells in PRP causes an important inflammatory reaction alongside white blood cells. Studies comparing Leukocyte-Poor Platelet-Rich Plasma and Leukocyte-Rich Platelet-Rich Plasma remain controversial [17,18]. In our study, the pain when using Monocyte-rich Platelet-Rich Plasma in the 2nd session was almost absent, which probably reflects a very mild inflammatory reaction. In the 3rd session, the addition of prolotherapy in the same time to the Monocyte-Rich Platelet-Rich Plasma created severe pain, but of less duration than in the 1st session, probably related to a rapid absorption of the inflammation.

In our two previous articles, the uptake of contrast in osteochondritis of the knee and non-union of the scaphoid was total from the first session [19,20], but of limited area in the necrotic surface of the femoral head, gaining after each session in territory suggesting a different healing process at the hip, already known as slow [1,4].

The appearance of bone consolidation allows the stabilization of the osteonecrosis and therefore delay the progression to total prosthetic replacement [21]. This result was seen radiologically only after the 3rd session, which may suggest a synergistic effect due to the simultaneous use of Prolotherapy and Monocyte-rich Platelet-Rich Plasma, which can lead to greater activation of the healing process. Additional studies are still needed.

Conclusion

Osteonecrosis of the femoral head remains a serious and disabling disease. The disease is characterized by the lack of parallelism between the clinical signs and the late radiographic signs, which may appear several months or even years later after the onset of symptoms.

To date, no effective treatment exists to improve the repair process in osteonecrosis of the femoral head, especially after the appearance of the sub-chondral fracture where the evolution towards prosthetic replacement becomes inevitable. However, the fracture may be a good time to use biological healing factors. Cell therapy in full development could become a therapy of 1st choice.

The PRP a developing technique rich in healing factor, whose beneficial effects have not yet been elucidated, could become a good therapy in osteonecrosis of epiphyses, in particular the femoral head.

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