



Review

Italian experience on use of E.S.W. therapy for avascular necrosis of femoral head



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H I G H L I G H T S

- Osteonecrosis of femoral head is a clinical disease due to a severe bone vascular disease.
- Associated to intense pain and loss of joint function, with incidence of 0.1% and unknown aetiology.
- Many classifications exist to describe it and say in final stages patient need THA.
- In early stages ESWT give excellent responses.
- Neapolitan school studied more than 600 patients who had very good results in early stages.

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A B S T R A C T

Osteonecrosis (avascular necrosis) of the femoral head is a clinical disease due to a severe bone vascular alteration associated with intense pain and loss of joint function, with an incidence of 0.1% and unknown aetiology. Many classifications exist to describe it and in the final stages the patient will need a total hip arthroplasty.

In the early stages, ESWT has given excellent responses.

The Neapolitan school studied more than 600 patients who had very good results in I and II stages of Ficat and Arlet Classification, with an improve of outcomes in VAS and HSS scores. Moreover it has shown a complete restoration of the signal intensity of the femoral head in MRI.

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1. Introduction

Osteonecrosis of femoral head is a disabling clinical disease due to a severe bone vascular disease. It is associated with intense pain and loss of joint function and has an incidence of 0.1%. Its real aetiology is still unknown.

Osteonecrosis is divided into various stages and in its final stages the only possible treatment is prosthetic replacement, but in the first stages it is still possible to use focused extracorporeal shock

waves. In this way we can obtain an improving of bone vascular quality. This method is particularly efficient in stage 1 and 2 (Ficat and Arlet classification), in which a complete recovery is still possible.

1.1. Clinical aspects

The disease is characterized by reduced local blood flow and death of the osteocytes and the bone marrow. During bone repair process, the predominant resorption of necrotic bone exceeding bone formation frequently leads to a progressive destruction of bone architecture, subchondral fracture, extensive hip pain, and loss of joint function. In young adults it is often a consequence of a violent trauma or a medial femur neck fracture, but in most cases is

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idiopathic.

For staging osteonecrosis, right iter is: radiography, MRI and bone biopsy. CT, scintigraphy and PET are not necessary.

1.1.1. RX

The required projections are the anteroposterior and the axial. Ficat and Arlet describe four radiographic classes:

Stage I: normal rx;

Stage II: sclerotic areas, which correspond histologically to the region with bone neoformation on necrotic trabeculae, alternating with radiotransparent areas, signs of fibro vascular tissues, in femoral head surfaces. There are no alterations of head profile;

Stage III: flattening of femoral head with many trabecular fractures. A typical sign of trabecular fractures is the crescent line of radiotransparency within the framework of the necrotic bone parallel to joint line;

Stage IV: osteoarthritis.

1.1.2. MRI

It is important for diagnosis and for monitoring the treatment.

In SE T1-weighted images, or in STIR, there is hyperintense line sign, which shows the border zone between normal and ischemic bone. In T2-weighted images, hyperintense areas appear, due to the increase of water content related to hypereamia of the fibrovascular tissue (Fig. 1).

1.2. Classification

There is not only one kind of classification in osteonecrosis of femoral head. Ficat and Arlet classification consists of six stages (from 0 to 4, separating 2A and 2B). The extent of the lesion is classified as minimum (radiographic involvement of less than 15% of the femoral head), moderate (15–30%) and severe (more than 30%).

Japan Investigation Committee proposed a new classification in 3 types:

- A: medial lesion of femoral head, with low risk of progression;
- B: central lesion, with intermediate severity of prognosis;
- C: lateral lesion, with worst prognostic value.

The Association Research Circulation Osseus (ARCO) proposed another classification about the disease. It maintains the 4 stages of FA classification, adding not only the concept of quantification of the involvement of femoral head, but the localization of the lesion too, as proposed by JIC.

1.3. Treatment

In about 85% of untreated osteonecrosis at stage 1 or 2 by Ficat, femoral head collapses in 5 years, for this reason is important to treat all forms in the initial stages.

At the beginning a conservative approach is preferred. It consists in ban load, using two crutches for 8–12 weeks, practising physiotherapy in order to preserve muscle tone, and using said to control pain. On the contrary, surgical approach may consist in forage, osteotomy, bone graft, hemiartroplasty or THA.

Between these two families of treatment, shock wave therapy finds represents an important route to conservative approach or as a last attempt to retard surgical treatment.

1.4. ESWT

This treatment is based on the evidence of improving the quality of the bone in pseudarthrosis; it happens because there is an increasing of vascularization, VEGF and nitric oxide.

Based on first positive experience in treatment of Kienbock's disease in 1996, Orthopaedic School of "University of Naples Federico II" started to treat osteonecrosis of femoral head with ESWT; more than 600 patient from 1996 to today have been treated with an electromagnetic lithotripter with a coil, the Modulith SLK manufactured by Storz Medical AG, supplied with targeting from navigation with an infra-red camera. The characteristic of the device are the following:

- Focal depth (16 cm)
- Focal point dimension (4 mm × 50 mm)
- In-line radiographic and ultrasound
- Extensive spatial orientability of the shock wave source
- Extreme precision of the computerized targeting.

Patient is positioned in a supine position, and a possible radioscopic recognition in anteroposterior and with a rotation of 30° to better identify the area. It is possible an ultrasound recognition too, to identify the depth and soft tissue.

Standard treatment consists in 2–4 session at 24 h intervals with progressively increasing power up to a maximum of 0.69 mJ/mm² and with a number of 3000–4000 impulses per session. During the treatment patients walk with crutches and without load on treated limb. If after the first cycle patient still shows pain, it is possible to practice another treatment with the same characteristics of the first after 1 month.

The follow up expected only clinical examination after 1 month, at three and six months MRI is required too.

2. Results

The results obtained were:

Table 1. Ficat-Arlet Classification

Stage	Symptoms	X-ray	Scintigraphy
0	None	Normal	Reduced capture
1	None to mild	Normal	Reduced capture
2	Mild	Change in density	Increased capture
2A		Sclerosis or cysts	
2B		Applanation (crescent sign)	
3	Mild to moderate	Loss of sphericity	Increased capture
4	Moderate to severe and/or acetabular changes	Reduction of the articular space	Increased capture

Fig. 1. Ficat and Arlet classification.

An excellent pain response in stage I with an HSS satisfactory;
In stage II the total disappearance of pain may require a second cycle of treatment, applicable to less than 25% of the cases; HSS not always satisfactory;
In stage III is observed a reduction of pain only for short time with a HSS poor.

MRI control shows complete restoration of the signal intensity in stage I and in stage II with a satisfactory HSS, whereas shows a reduction of hyper intensity in stage II with unsatisfactory HSS and stage III.

Evaluation with VAS score shows:

Disappearance of pain in 36% of cases;
Stable reduction of pain by at least 70% in 43% of cases;
Pain unchanged in 21% of cases

It is important to underscore if pain disappears or reduces but a deficit of articular excursion remains, it is due to the immobilization in treatment period. Physiotherapy can solve this problem.

3. Conclusions

ESWT is an effective and non-invasive treatment of ONFH. Its efficacy is greater in initials stages of the disease and is still more effective than core decompression and bone grafting.

The authors believe it may be the treatment of choice in the early stages of necrosis of the femoral head.

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Author contribution

Sergio Russo, conception and design, writing, final approval of the manuscript.

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Conflicts of interest

Nothing to declare.

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