Treatment of Non-septic Femoral Head Necrosis with a Vascularized Iliac Crest Graft

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Introduction. We present our experience of the treatment of aseptic femoral head necrosis with a vascularized iliac crest graft. This was a retrospective study of 25 hips (22 patients) operated in our hospital between June 1993 and September 2002.

Materials and methods. There was a majority of men, 20 cases; and the left side was most frequently affected. The main predisposing factor was alcoholism, 8 cases. No predisposing factor was found in 5 cases. All the patients were assessed clinically according to the Harris scale and by X-rays according to the modified Ficat-Arlet staging system to determine necrosis progression. The mean follow-up was 4 years.

Results. Mean functional assessment was 87 points. Results were: excellent and good, 76%; fair and poor, 24%. Some degree of deterioration was detected on X-ray in 40% of the hips with a mean of 5.2 years. According to radiological assessment criteria satisfactory evolution was seen in 66%.

Conclusion. Our results are comparable to those seen in the literature. No progression of necrosis was seen on X-rays in 60% of the patients operated.

Key words: *femoral head necrosis, bone transplant, neovascularization, iliac.*

El injerto vascularizado de cresta ilíaca en el tratamiento de la necrosis aséptica de la cabeza femoral

Introducción. Presentamos nuestra experiencia en el tratamiento de la necrosis aséptica de la cabeza femoral con el injerto vascularizado de cresta ilíaca mediante el análisis retrospectivo de 25 caderas (22 pacientes) intervenidas en nuestro hospital entre junio de 1993 y septiembre de 2002.

Material y método. Predominio de hombres con 20 casos y del lado izquierdo. El factor predisponente más numeroso fue el abuso del alcohol en 8 casos. No se encontró en 5 casos. Todos los pacientes fueron evaluados clínicamente según la escala de Harris y radiológicamente se valoró la progresión de la necrosis según la clasificación de Ficat y Arlet modificada por la ARCO con un seguimiento medio de 4 años.

Resultados. La valoración funcional media fue de 87 puntos con un 76% de excelentes y buenos resultados y un 24% de regulares y malos resultados. El 40% de las caderas sufrió algún tipo de deterioro radiológico con una media de 5,2 años. Según los criterios de valoración radiológica, el 66% evolucionó satisfactoriamente.

Conclusión. Nuestros resultados están en la línea de los publicados en la literatura sin evidenciarse la progresión radiológica de la necrosis en el 60% de los pacientes intervenidos.

Palabras clave: *necrosis de la cabeza femoral, trasplante de hueso, neovascularización, ilíaca.*

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Aseptic necrosis of the femoral head is a condition that affects young adults, often bilaterally. The condition may evolve similarly or differently in both hips, the latter being the most common situation. This is a disease that presents, even today, several controversial elements mainly related to its patogenesis and treatment.

Different therapeutic methods have been proposed to preserve the femoral head: forage-biopsy[1], several types of

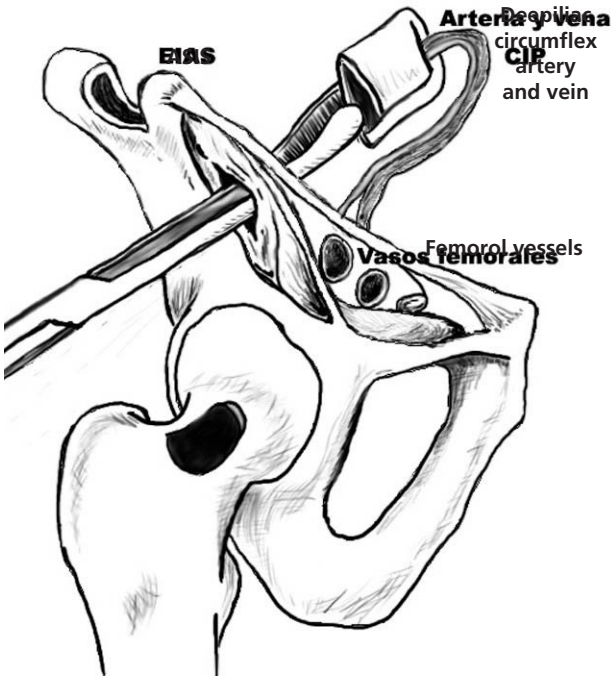

Figure 1. *Diagram of the procedure as described by Leung. The iliac crest graft was harvested with the vascular pedicle made up of the deep iliac circumflex artery and vein. It is slid under the inguinal ligament to be subsequently introduced into the femoral neck through a fenestration on its anterior cortex. ASIS: anterosuperior iliac spine.*

osteotomy[2-5] and techniques aimed at revascularizing the necrotic area. The use of conventional bone grafting[6,7] and muscular pedicle[8-10] has currently been superseded by the use of vascularized bone grafts. The most widely used ones are vascularized fibular grafts[11-14] y and vascularized iliac crest grafts[15-20]. The use of vascularized iliac crest grafts, perfused by the deep circumflex iliac artery, a branch of the external iliac artery, entails a series of advantages that make it ideal for our hospital setting, providing us with results similar to those obtained with vascularized fibular grafts[20]. The most significant advantages of this type of graft are that microsurgical techniques are not needed, the excellent quality of live cortico-cancellous provided and the brevity of the surgical time required.

In this retrospective study we would like to contribute our 9-year-long experience treating femoral head aseptic necrosis with vascularized iliac crest grafting.

MATERIAL AND METHOD

Between June 1993 and September 2002 we treated in our hospital 22 patients (25 hips) diagnosed with femoral head aseptic necrosis with vascularized iliac crest grafts. We included in our study all those patients who presented with a stage II or II necrosis according to the classification by Ficat and Arlet[21] as modified by ARCO[22], excluding cases that did not fall within these stages. Twenty were male and 2 female. Mean age was 39.4 years (range: 17-59 years). There was prevalence of the left side (11 cases), with 8 right cases and 3 bilateral cases. All patients were clinically and radiologically evaluated over a mean period of 4 years (range: 1-9 years).

Eight patients had a history of alcohol abuse, 2 had hypercholesterolemia, 3 post-traumatic fractures (2 hip dislocations and 1 basicervical fracture), 1 hemolytic anemia hemolítica (thalasemia), 1 dysbaric injury, 2 multifactorial cases (corticoids, alcohol and hypercholesterolemia) and in 5 no risk factors were found.

Surgical technique, post-operative period and rehabilitation

We followed Leung et al's original technique[23], according to which a double incision is made. The superior branch, which is similar to that used in the ilioinguinal approach and runs from the upper margin of the iliac crest (1 cm above the inguinal ligament) up to the beating point of the external iliac artery, is performed to dissect the pedicle and extract the graft. The descending branch runs from the anterosuperior iliac spine distally about 10 cm performed to approach the hip anteriorly. The pedicle of the deep circumflex iliac artery lies immediately below the conjoint tendon, which must be released until its proximal portion in order to achieve a better range of movement. The mean size of the grafts harvested was 2 x 2 and 2 x 7 cm. About 3 cm of the anterosuperior iliac spine must always be preserved. Once the graft has been harvested and the anterior hip arthrotomy has been carried, a tunnel is bored into the femoral neck to allow the emptying of the necrotic area and the placement of the graft, which is taken under the inguinal ligament (fig. 1). A technical detail that makes this last step easier is a section of the tendon at the reflex portion of the rectus femoris. Before applying the graft, small fragments of cancellous bone are introduced. In our first few patients we attached the graft to the neck by means of a 3.5 mm titanium cancellous screw, but at present we position in with an inlay grafting technique, without any fixation device. Mean OR time has been 2.5 hours. None of our patients had to be transfused.

We also followed Leung et al's postoperative guidelines[23] keeping the hip flexed and internally rotated for 3 weeks to relax the pedicle. Subsequently, walking was permitted but with no weight bearing for 6 months. Weight-bearing assisted with crutches was indicated until proprioceptive recovery, which occurred at 2-3 months.

In our first few patients, we conducted a gammagraphy 6 months into the post-op period. At present we prefer to carry out a nuclear MRi (fig. 2).

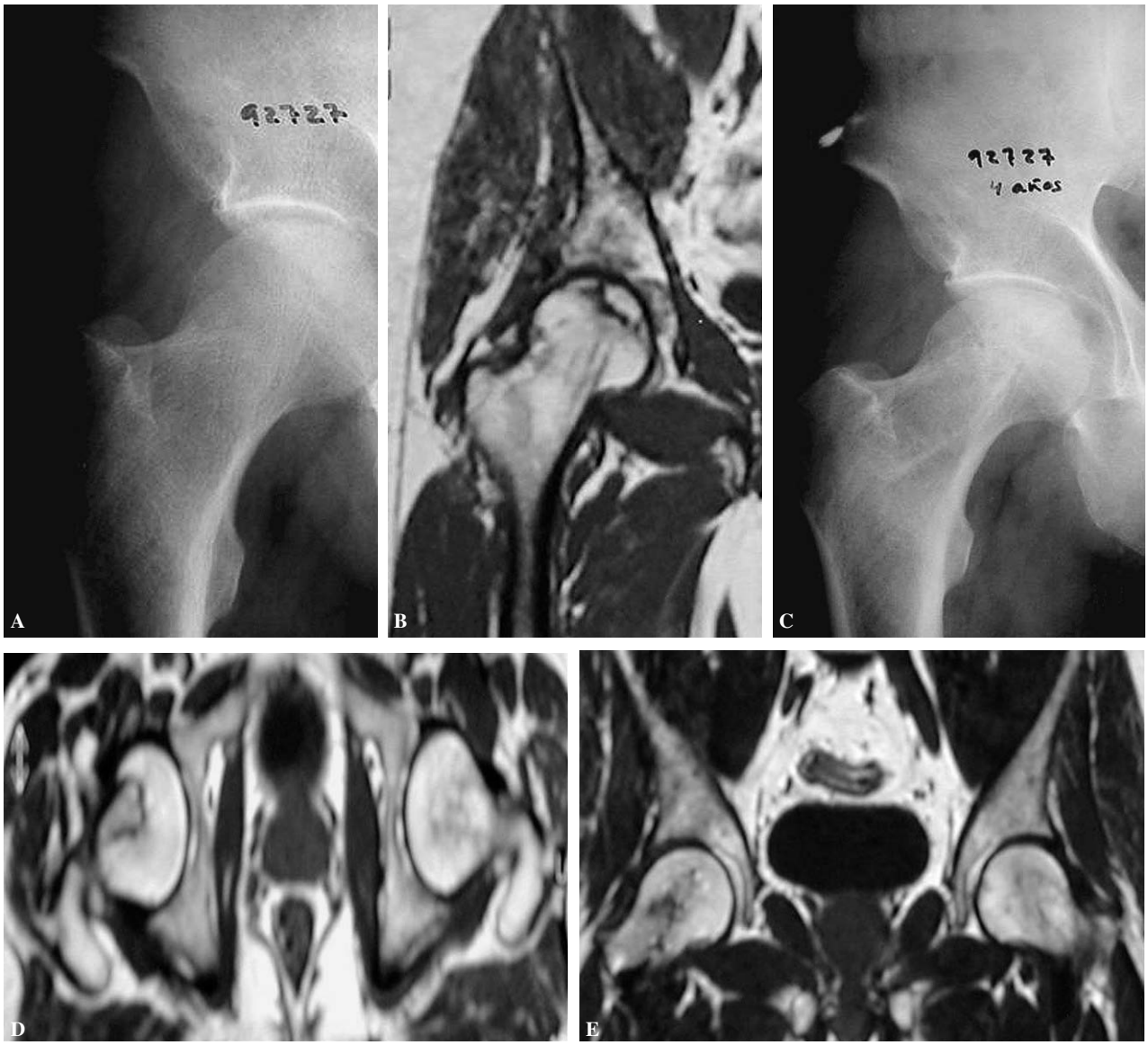

Figure 2. *(A and B) X-rays and nuclear MRi of a stage IIb aseptic necrosis. (C) Post-op control showing graft incorporation with no radiological evolution of the necrosis. (D and E) Nuclear MRi showing graft incorporation and no necrotic signs at 4.5 years..*

Assessment of results

Clinical results were assessed following the Harris Hip Score[24]. Other parameters evaluated included: return to previous job, change of jobs or permanent disability leave. An analysis was made of the patients' pre- and post-operative radiological status at the time of clinically assessing the anteroposterior and axial view of their hips according to the classification by Ficat y Arlet[21] as modified by ARCO[22].

Patients with a collapse of less than 2 mm with no involvement of the joint line were ranked as having a satisfactory result (fig. 3) Those with subsidence of 2 mm or more and with joint degeneration were ranked as unsatisfactory.

RESULTS

Clinical results

The mean assessment according to the Harris Hip Score[24] was 87 points. Eight hips (32%) had an excellent result with a score higher than 91 points. Eleven hips (44%) had a good result with scores between 81 and 90 points. Two hips (8%) had fair results and 4 (three patients, 16%) had poor results.

If we separate hips with an evolution of more than 4 years from those that were operated less than 4 years ago, we can see a sharp difference in results: 64.29% of cases that have had at least a 4-year evolution show good and excellent results and 28.57% have had poor results, whereas

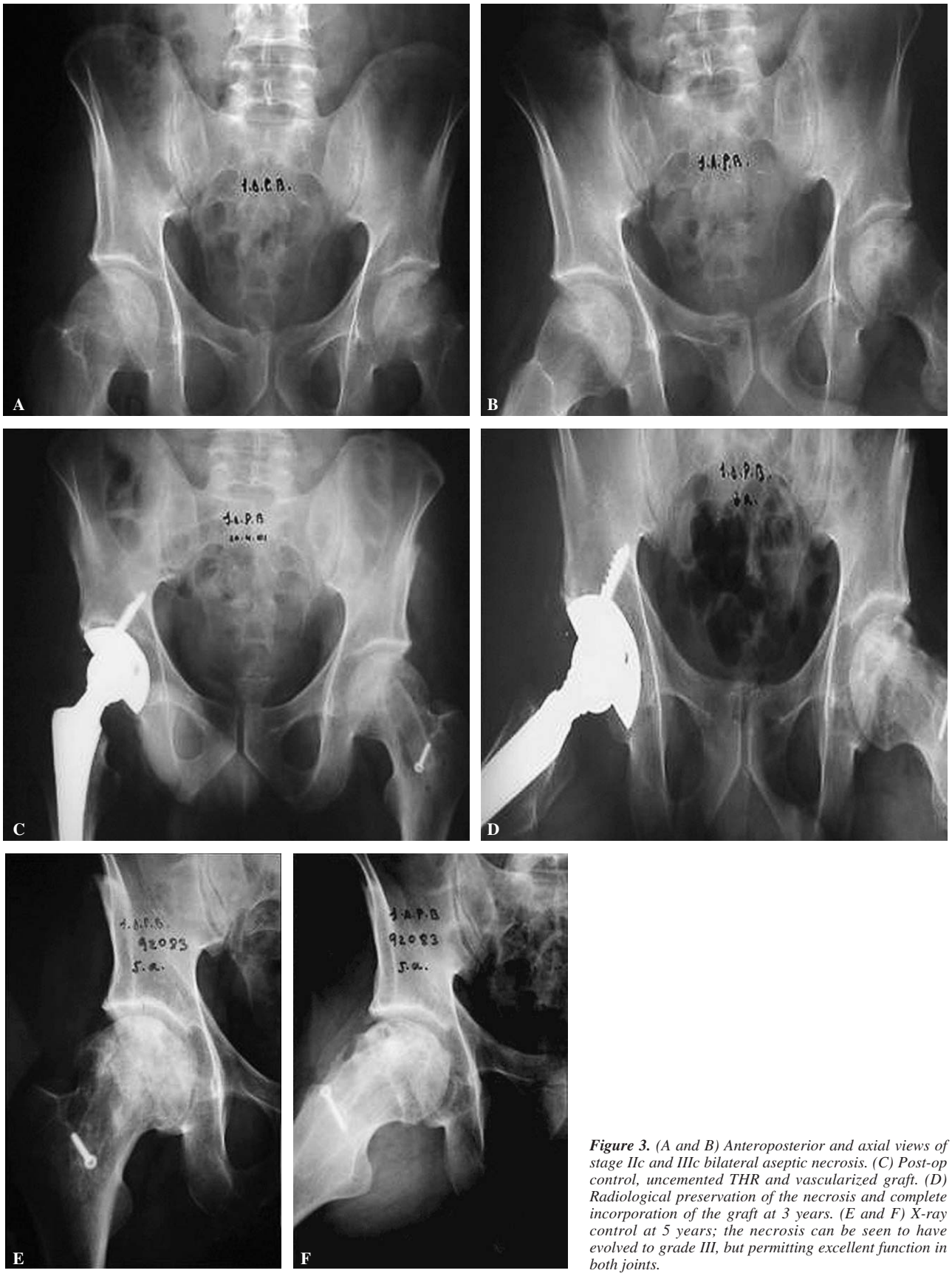

Figure 3. *(A and B) Anteroposterior and axial views of stage IIc and IIIc bilateral aseptic necrosis. (C) Post-op control, uncemented THR and vascularized graft. (D) Radiological preservation of the necrosis and complete incorporation of the graft at 3 years. (E and F) X-ray control at 5 years; the necrosis can be seen to have evolved to grade III, but permitting excellent function in both joints.*

Figure 4. *(A y B) Anteroposterior and axial view of the hip with stage IIIa .aseptic necrosis (C and D) Early evolution with no incorporation of the graft, which appears to have risen above the subchondral fracture site. (E and F) Evolution at 5.5 years without radiological progression of the necrosis.*

for cases with less than 4 years' evolution the scores are 90% of good and excellent results and 0% of poor results.

Eleven patients (50%) went pack to their usual job, 3 had to change jobs, one of them after 5 years in his usual job, and 7 had some kind of occupational disability (2 of them due to a poor clinical result and 5 due to a prosthetic surgery in the contralateral hip). One patient with a good clinical job is not in employment.

Predisposing factors related to poor clinical results were alcohol abuse in 2 patients (3 hips) and a hip obturator dislocation in another patient.

RADIOLOGICAL RESULTS

According to the classification by Ficat and Arlet[21], modified by ARCO[22], in the post-op, 4 hips were in radiological stage IIa, 11 in IIb, 5 in stage IIc, 2 in IIIa and 3 in IIIb. Of the 25 hips, 10 (40%) had some type of radiological evolution. Of the stage IIa hips, one evolved to IIb; of the IIb hips, 2 evolved to stage IIc y and one to stage IIIb; of the IIc hips, 1 evolved to stage IIIc (fig. 3) and one to stage IV; of the IIIa hips one evolved to stage IIIc and the other showed no progression at 5.5 years' follow-up (fig. 4); all of the stage IIIb hips evolved to stage IV (table 1).

Radiological evolution changes were detected on average at 5.2 years (range: 3-7 years) (figs. 3 and 5). According to the radiological assessment criteria, 66% of hips evolved satisfactorily and 24% did so unsatisfactorily.

Complications

Our most significant complication was a femoral nerve paresis that recovered spontaneously at 3 months; as well as

Table 1. To assess the radiological post-operative progression of the necrosis we compared the pre-op radiological status with the current radiological status, i.e. at the end of follow-up

Pre-op status	Current status	No.	%
IIa	IIa	3/4	75%
IIa	IIb	1/4	25%
IIb	IIb	8/11	73%
IIb	IIc	2/11	18%
IIb	IIIb	1/11	9%
IIc	IIc	3/5	60%
IIc	IIIc	1/5	20%
IIc	IV	1/5	20%
IIIa	IIIa	1/2	50%
IIIa	IIIc	1/2	50%
IIIb	IV	3/3	100%

No: number of patients showing progression of the necrosis in each of the groups;%: percentage of necrosis progression in each group.

4 femorocutaneous nerve pareses, also transient. We had no infections or herniations.

DISCUSSION

The current trend in the treatment of aseptic necrosis of the femoral head is aimed at preservation in the initial stages and at the delay of joint replacement surgery in advanced cases, since it tends to affect young patients who should logically be offered – at least initially – the possibility of retaining their femoral head.

Vascularized bone grafting favors the revascularization process of the necrotic site given the scarce osteoblastic formation that occurs in healthy bone. It contributes cortical and medullary bone structure rich in osteoinductive factors and acts as both a support that helps avoid the collapse of the femoral head and a vascular and perivascular structure with the supply of osteogenic precursor cells[25].

Ganz and Jacob[26] were the first to use vascularized iliac crest grafts, associating them to a 50∞ flexion osteotomy. Recently Fuchs et al[27] have published the long-term results of 41 patients (52 hips) operated with this technique, which they recommend only for young symptomatic patients in Ficat's radiological stage II[21].

Leung[15] reported that in 11 out of 21 patients operated (52.4%) necrosis evolved after a 63-month follow-up period. The majority of his patients were between stages II and IV of Ficat and Arlet's classification[21]. In contrast with these results, Hasegawa et al1[6] report that in 14 out of 30 femoral heads (46.6%) treated with a vascularized iliac crest graft necrosis did not change its radiological status after 8 years' follow-up. In 12 out of 27 patients, necrosis was classified as stage II, according to the classification by Ficat and Arlet[21]. Schwetlick et al[17,18] reported that in 75% of their patients (27 out of 36) necrosis remained in the same radiological stage after 21.2 months and only started deteriorating at 25 months. Conversely, Ishizaka et al[19] reported that in 51.6% of their patients (16 out of 31) necrosis did not change its radiological status after a 6-year evolution. Eisenschenk et al[20] reported that in 56.1% of their cases necrosis remained at the same radiological stage (according to ARCO's classification[22] after 5 years' follow-up; 75,6% were in stage II, 1.2% in stage III and 23.2% in stage IV. In our study, using the same classification system, we found that in 60% of the operated hips necrosis remained at the same radiological stage after a mean follow-up of 5 years (figs. 2, 4 and 5). Eighty percent were at stage II and 20% at stage III. However, unlike Eisenschenk et al[20], we considered group changes within the same radiological stage, according to ARCO's classification[22], and observed that in hips showing a greater dissemination of necrosis (groups B and C) lesions tended to progress more (table 1).

Table 2. Comparison of the number of cases, the length of the follow-up period (in years) and the percentage of necrosis progression in the different papers found in the literature, including our own results

	Cases	Follow-up (years)	%
Leung[23]	21	5	52.4
Hasegawa[16]	30	8	46.6
Schwetlick[18]	27	2	75
Ishizaka[19]	31	6	51.6
Eisenschenk[20]	82	5	56.1
Cano (this paper)	25	5.2	60

From the analysis of these series with long-term follow-up and of the results obtained in our study, one can conclude that in over 55% of ARCO[22] stage II and III patients operated with this technique, necrosis remains stabilized after a mean follow-up of 5 years (figs. 2, 3, 4 and 5) (table 2). The best results are obtained in series including patients operated at earlier evolutional stages.

These results are similar to those obtained with vascularized fibular grafts[11-14] and there exists a certain controversy as to which method is most effective. In our view, vascularized iliac crest grafts offer advantages that make them ideal for use in the hospitals in our environment since only one surgical team is necessary, they do not require microsurgical anastomosis and they can be applied in a relatively short period of time. Their greatest drawback is related to the need for 3-week postoperative immobilization to avoid excessive pedicle traction.

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Figure 5. *(A) Anteroposterior x-ray of a stage IIc hip. (B and C) Early postoperative control that shows the emptying of the cyst area, which is then filled with graft. (D, E and F) Evolution at one and three years without progression of necrosis and graft incorporation. (G) Evolution at 6 years without radiological progression of the lesion and contralateral stage IIc necrosis. (H and I) Results at 6 years and 8 months with a slight cephalic irregularity. The contralateral hip shown no signs of graft incorporation at 6 months.*

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