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Influence of Clinical and Radiological Variables on the Extent and Distribution of Periprosthetic Osteolysis in Total Hip Arthroplasty with a Hydroxyapatite-Coated Multiple-Hole Acetabular Component: A Magnetic Resonance Imaging Study

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ABSTRACT

Polyethylene wear-induced osteolysis constitutes the most severe long-term complication of total hip arthroplasties (THA). Our aim was to assess through MRI the severity and growth pattern of osteolysis, as well as the influence clinical-radiographic variables exert. We analyzed 75 THA with an average evolution time of 13.67 years. The implant was a titanium alloy, non-cemented, multiple-hole model with hydroxyapatite coating. Osteolysis was found with a peripheral pattern in 48 and a central pattern in 6; in 52 cases it was continuous, and in 4, isolated. Out of 118 screws, 20 exhibited lysis. There was a proportional correlation between osteolysis severity and wear rate with age, physical activity and acetabular abduction, as well as an association between said variables and peripheral and continuous patterns.

With the advancements in orthopedic surgery and the improvements in total hip arthroplasty design, instability and implant loosening issues have been overcome. Thus, friction component failures have now become the greatest problem. Developments in tribology and the refinement of friction torques have allowed for the extension of implant survival well over a decade. In this respect, polyethylene combined with metals or ceramics has exhibited an optimal behavior. Paradoxically, during these long periods of survival, polyethylene wear and wear-related osteolysis are still causes of failure in total hip arthroplasties in the long term [1–4]. This process starts as an inflammatory response against particles produced by the wear of the liner, and several factors condition the severity of the disease [2,5–7]. The therapeutic approach is complex because diagnosis is usually late, this being a "silent" process. Diagnosis is derived from the complications the disease may generate, especially aseptic loosening [8–11]. Due to the lack of specific symptoms until the disease reaches an advanced stage, conventional radiography (RX) may be the best instrument that allows us to pinpoint the disease. The low cost of this procedure, together with acceptable accuracy and specificity, makes radiography the first method of assessment. However, its scarce utility in the multiplanar study of the disease has furthered the use of three-dimensional techniques, such as computed tomography (CT) and magnetic resonance imaging (MRI) [12,13]. CT is useful in determining the extent and volume of osteolysis during surgical planning [14,15], but MRI is the most sensitive non-invasive method for the detection of osteolysis, because it is more precise than CT at spotting bone loss and allows for the study of the disease not as a series of unrelated lytic lesions, but as a continuous granuloma formation, which is a constant in the extension of this pathology [16–20]. MRI also allows us to learn how osteolysis develops in terms of location and magnitude. Nowadays, it is known that osteolysis follows a continuous and peripheral pattern in uncemented THAs, and that whenever acetabular holes are present, lesions build up around them [21–23]. This pattern is influenced by how PE wear particles spread. Some authors, such as Schmalzried [24] and Anthony [25], have proposed that variations in hydrostatic pressure push wear particles through what has been defined as "effective joint space." This space originates mostly in a continuous fashion from the peripheral rims of the implant and, to a lesser extent, from the screw holes. Although factors related to greater wear and more osteolysis have been described [2,5–7,26,27], there are no MRI

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studies which may allow to establish a direct relationship between the different causal factors and the extent and pattern of lesions.

The aims of our study were:

1 To analyze the severity of osteolytic lesions, their spreading pattern and degree of continuity, assessing whether their progression matches the concept of "effective joint space."
2 To determine which clinical and radiographic factors have an impact on the magnitude and topography of the aforementioned osteolytic progression pattern, as well as the influence the type of implant used may exert.
3 To find out the repercussions of the presence of acetabular screw holes in the onset and development of periprosthetic osteolysis.

Materials and Methods

Our study was based on a sample of 75 consecutive cases of long-term evolution THAs implanted in a single hospital between 1992 and 1999 with an average evolution time of 13.67 years [6–18] (mean of 15). All cases featured primary surgery and the same model of uncemented arthroplasty was implanted (BihaPro, Biomet, UK), which consists of a multiple-hole hydroxyapatite (HA) coated porous acetabular component with three peripheral flaps for primary fixation, and an HA coated metaphysiary circumferential porous femoral stem with metaphysiary support, featuring a metal-PE friction torque and 28-mm chromium-cobalt head. The PE-acetabulum fixation systems used were the Hex-loc system in the case of the 18 THAs implanted before 1994, and the Ring-loc system in the other 57. The polyethylene employed was ultra-high-molecular-weight PE (UHMWPE), sterilized with gamma radiation. Only those cases with a valid clinical and radiographic follow-up were included. Patients who had undergone any sort of revision surgery before being enrolled in the study and who had no preoperative MRs were excluded. Those who did have MRs were included.

The series comprised 52 patients, 29 men and 23 women, and there were 23 bilateral cases. Average age at the time of surgery was 56.64 years (29–78, SD: 9.731). Patients included in the study signed an informed consent form and the guidelines set by the regional Ethics Committee were followed. The indication for surgery was primary coxarthrosis in 56 cases, hip dysplasia in 8, aseptic necrosis of the hip in 7, and other causes in 4. Surgical approach was anterior in 55 cases, lateral in 4, and posterior in 16. The implant was placed on the right side in 38 cases and on the left side in 37 cases. A total of 118 screws were inserted in 55 of the 75 acetabular components in the series (1 screw in 5 cases, 2 in 37 cases, and 3 in 13 cases).

All patients followed a clinical and radiographic follow-up protocol as part of the hospital follow-up procedure, which took place one, three, six and twelve months after surgery, and once a year afterwards. Furthermore, at the time of enrolment in the study and before performing the MR, a new assessment was carried out according to the parameters set in the aforementioned protocol. Since the entity of the protocol is remarkable, we proceed to detail the variables we used in this study: the etiology of the arthrosis and convenience of surgery, the surgical approach, whether the implant was unilateral or bilateral, the side undergoing surgery, age, gender, height, weight and body mass index (BMI) of the patient. A full medical history and a physical examination allowed for the clinical and functional evaluation according to Merle D'Aubigé's scale as modified by Chamley [28]. This scale assigns a score between 0 and 6 to each of three variables (pain, gait and mobility) and classifies the clinical outcomes of surgery according to the increase in the resulting overall score obtained by adding the scores of the three variables. Physical activity was measured by an additional 6-degree score: bed, sedentary, semi-sedentary, light, moderate and high. For the radiographic study at least two simple projections were obtained, including an antero-posterior radiograph of the pelvis centered on the pubic symphysis. The radiographs were used to analyze a series of variables we considered could be related to osteolysis: height of the greater trochanter with respect to the center of the femoral head, acetabular abduction (defined as the angle formed by the axis of the largest diameter of the acetabular cup and the bi-ischial line), extent of bone covered by the HA coating of the stem and the acetabular cup (defined as the distance in mm from the end of the HA coating and the last spot where HA is in contact with the bone), eccentricity of the prosthetic head, and polyethylene wear rate. PE wear rate was measured only in the last digitized set of radiographs for each case, comparing them with the immediate postoperative ones using the ROMAN software version 1.7 [29–31]. This program calculates wear based on the penetration of the prosthetic head in relation to the center of the acetabular cup. Whenever both centers coincide in the post-operative radiograph, the software performs a simple analysis, measuring the distance from the center of the head to the center of the acetabular cup in the last radiograph. If centers do not match in the post-operative radiograph, the software calculates penetration by means of a paired analysis, such as the relative displacement of both centers over time. Radiographic suspicion of osteolysis was also taken into account, based on the detection of radiolucencies around the implant or osseous cysts in the acetabular Lee-Charnley zones and in the femoral Gruen zones [32].

Finally, 75 MRs were also performed, one for each THA, using a Philips Achieva 1.5 T (Koninklijke Philips Electronics N.V., Amsterdam, The Netherlands) device in all cases. In order to achieve a good quality and minimize artifact interferences, we followed the guidelines described by Potter [18,19]. The study technique described below was performed according to those recommendations. At least three sequences were carried out: axial T1-weighted fast spin-echo (FSE), coronal T1-weighted FSE, and coronal T2-weighted FSE at 3-mm slice thickness in all cases. Whenever a more precise evaluation of the lysis areas in the acetabular region was required, an additional sagittal T1-weighted FSE sequence at 3-mm slice thickness was performed in order to add a supplementary slice plane which may help to further understand the three-dimensional nature of the process. If the axial T2 FSE sequence revealed any cystic changes in the skeleton or the regional soft tissue, a final coronal T2-weighted FSE sequence was performed to obtain a more precise definition of such changes. When choosing the acquisition parameters, we gave preference to spatial resolution (a 3-mm slice thickness in all cases and 384×317 imaging acquisition matrices). If a patient's build required a higher number of slices than usual the number of acquisitions (NSA) was reduced from 6 to 4, thus shortening the study period significantly. The same approach was used whenever a patient did not tolerate the examination well. To sum up, the average parameters for a T1-weighted sequence were: TR = 550, TE = 16, FSE Turbo = 3, NSA = 6; acquisition matrix = 384×317, which allows for a 512×512 reconstruction matrix. Parameters for T2: TR = 5700, Te = 140, FSE = 19, NSA = 4, matrix = 384×319.

Presence of osteolysis, its extent, the location of the lytic lesions and the growth pattern (central or peripheral and continuous or isolated) were analyzed in each MR. With that aim, a specific protocol defined before the study was followed. We thus considered two types of lesion:

(1) An osteolytic lesion defined as a zone of intermediate signal surrounded by a hypointense area which replaces the hyperintense signal of bone and which communicates with the joint, or
(2) A granulomatous lesion, defined as an area with the same signal features than an osteolytic lesion but without bone turnover.

In order to assess the location of the lesions, the pelvis was divided into five zones: the supra-acetabular ilium, the ilio-pubic branch, the pubis, the ischium, and the retro-acetabular ischium (Fig. 1). The femur was divided into the well-known Gruen zones Gruen [32]. The extent of osteolysis was determined according to the number of affected zones; the disease would be considered as "advanced" whenever 4 or more zones were compromised.

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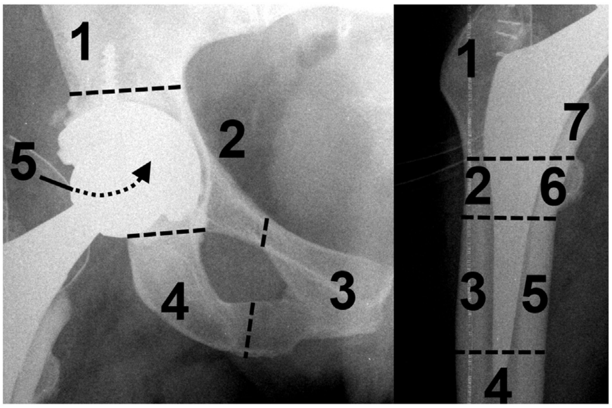

Fig. 1. Pelvic and femoral areas used to classify the location of the lesions. In the pelvis: 1. Supra-acetabular ilium; 2. Ilio-pubic branch; 3. Pubis; 4. Ischium; and 5. Retro-acetabular ischium. In the femur: 1–7. Femoral Gruen zones.

Finally, growth patterns were defined according to two features: spatial distribution (peripheral/central) and degree of continuity (continuous/isolated). A pattern is described as "central" when the lesion is located at the center of the acetabular component, far from the periphery of the acetabular cup, in direct communication with the joint through the acetabular screw holes. When a pattern is "peripheral", the lesion was in contact with the joint space through the periphery of the acetabulum, not through the holes. On the other hand, we defined the concepts of "continuous" and "isolated." These labels do not refer to whether the lesions are in contact with the joint space, which is taken for granted. A pattern was considered "continuous" whenever the lesions formed a single, large, continuous volume, whereas an "isolated" pattern implies that lesions appeared as independent, smaller volumes communicated with the joint space, but not among themselves. For those cases in which the patterns could not be clearly defined as one of the two main options (peripheral/central and continuous/isolated), two intermediate options were added to each set. To sum up, when it comes to distribution, lesions were classified as totally peripheral, predominantly peripheral, totally central and predominantly central. As for continuity, the options are totally continuous, predominantly continuous, totally isolated and predominantly isolated. Therefore, there are four possible patterns: peripheral-continuous, peripheral-isolated, central-continuous and central-isolated.

The presence of osteolysis around the screws was also analyzed, describing whether it manifested as isolated lesions or as part of continuous volumes. The evaluation of the MR images was performed anonymously by two independent radiologists who completed a questionnaire tailor-made for this study.

The values of the different variables were codified and added to a database using the SPSS Portable for Windows 7 software version 19 (SPSS, Inc., Chicago, IL). Afterwards, a statistical analysis of the variables was performed. The frequency of each value and of their combination was studied via an observational, descriptive and transversal analysis. Finally, mean comparison tests, variable correlation tests and regression studies were carried out to determine whether there were any relationships between the different variables.

Table 1
Frequency of Osteolytic Presentation in the Femoral and Pelvic Areas.

	Total	Pelvic Areas					Femoral Areas		
Degree of Lesion		1	2	3	4	5	1	2–6	7
Osteolysis (NO)	19	48	33	71	59	36	54	75	58
Osteolysis (YES)	56	27	42	4	16	39	21	0	17
Osteolysis <4 areas	39	14	25	0	6	24	11	0	6
Osteolysis ≥4 areas	17	13	17	4	10	15	10	0	11

Results

In 19 of the 75 cases studied no osteolytic lesions were detected through MRI. Out of those 19, 13 showed no sign of disease, and 6 displayed granulomatous lesion without osteolysis. Osteolytic lesions were found in 56 cases; 17 of them were considered as "advanced disease" (Table 1). Out of the 53 cases of pelvic osteolysis, supra-acetabular ilium involvement was present in 27 instances; ilio-pubic branch involvement, in 42; and retro-acetabular ischium, in 39. The 29 cases featuring femoral involvement gathered in Gruen zones 1 and 7.

Table 2 shows growth type, the predominant pattern, extent of lesion continuity and the combination of the different patterns. Most cases followed a totally peripheral pattern (32 cases) or a predominantly peripheral pattern (16 cases). Very few cases exhibited totally central [2] or predominantly central [4] lesions. Similarly, most cases exhibited totally continuous lesions (34 cases) or predominantly continuous lesions [18]. There were few instances of predominantly isolated lesions [4] and no totally isolated lesions. The most frequent pattern combination, the one comprising most cases of advanced disease, was predominantly peripheral and continuous, which was present in 48 of the 56 cases with osteolysis (Fig. 2). Thus, in the 85% of cases osteolytic lesions grew from the periphery of the implant and not from the holes, as a single continuous volume.

Images of each of the 118 screws implanted were analyzed (Table 3). We found that osteolysis was present only in 20 screws: 6 instances as part of central lesions and 14 as part of peripheral lesions. Finally, MRs revealed that there was some kind osteolysis-related fluid collection in 17 cases (Fig. 3).

Statistical tests of variable correlation revealed the presence of a direct, statistically significant relationship between PE wear and strolling and the patient's degree of activity and acetabular abduction. As expected, there was an association between PE wear rate and the magnitude of osteolysis. A statistically significant relationship was also found between the magnitude of osteolysis and years of evolution, strolling, physical activity and acetabular abduction, as well as an inverse relation with age at the time of initial surgery (Table 4). A multiple regression analysis confirmed the association between wear rate and a patient's physical activity. The same was true for the number of affected areas and years of evolution, age of patient,

Table 2
Presence of the Different Patterns and Extent of Lesion Continuity.

		Extent of Continuity				
		Continuous		Isolated		
Pattern Type		Totally Continuous	Predominantly Continuous	Totally Isolated	Predominantly Isolated	Total
Peripheral	Totally peripheral	32	0	0	0	32
	Predominantly peripheral	1	15	0	0	16
Central	Totally central	0	0	0	2	2
	Predominantly central	1	1	0	2	4
Mixed; no predominance		0	2	0	0	2
Total		34	18	0	4	56

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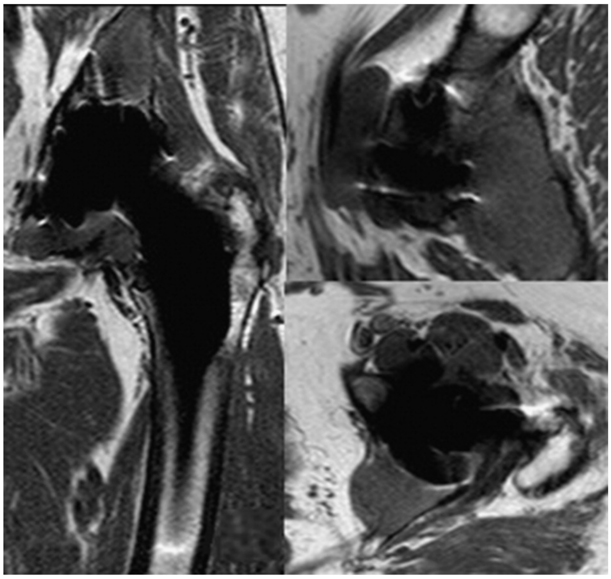

Fig. 2. Case of severe osteolysis with peripheral and continuous pattern affecting 4 of the 5 pelvic zones and femoral zones 1, 6 and 7. Upper right: sagittal section; lower right: axial section; left: coronal section.

and wear rate (Table 5). We did not find any significant relations between the other variables. Neither between the two types of acetabular fixation.

On the other hand, the existence of differences in the means of the variables when comparing groups with different growth patterns or different extent of lesion continuity became apparent (Table 6). Specifically, the ANOVA test revealed that peripheral patterns are more frequently associated with bigger-sized lesions, a greater wear rate, less acetabular abduction, and more years of evolution. In addition, continuous lesions are also more frequently related with bigger-sized lesions with a longer evolution time.

Discussion

This study has allowed us to learn about, assess, and analyze the nature and behavior of osteolysis in our series of long-term evolution THAs by using MRI. We were able to determine where lesions are located, where they spread to and which growth patterns they follow. The expansile nature of osteolysis requires that we study its development over time and its patterns; thus, MRI emerges as the method with higher sensitivity and specificity, especially for evaluating soft tissue or the presence of cystic formations [13,18–20,22,33,34].

In uncemented THAs, osteolysis tends to follow a peripheral, continuous growth pattern. Several concepts have been considered and studied in order to understand the reasons behind this growth. One of the most promising theories is that of the "effective joint space" concept. While analyzing our series, we found out that, overall, our cases are in keeping with that concept. It is possible that the particles responsible for the inflammatory response triggering osteolysis are stored within the synovial fluid and, accordingly, that their expansion would follow that of

Table 3
Presence and Osteolysis Pattern in Acetabular Screws.

Presence and Osteolysis Pattern	N
Screw osteolysis cases, total	20
Peripheral pattern	14
Continuous lesion	13
Isolated lesion	1
Central pattern	6
Continuous lesion	3
Isolated lesion	3

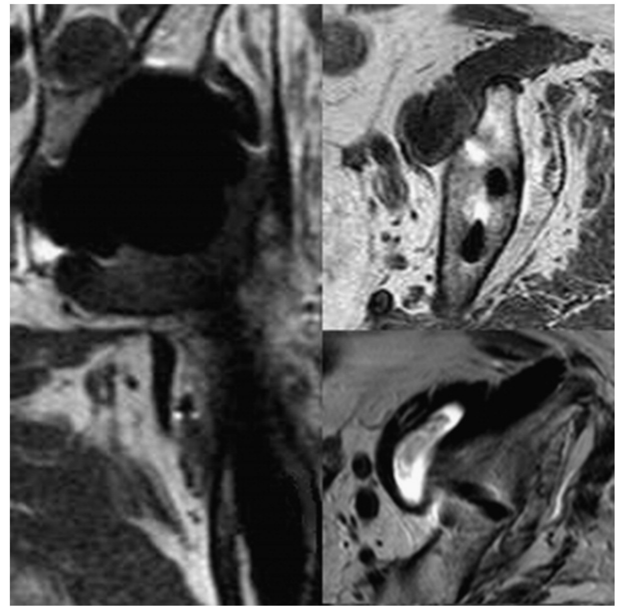

Fig. 3. Osteolysis with a mixed growth pattern and associated cystic lesion. Left: coronal section; right: axial sections in sequences T1 and T2, where the fluid content of the lesion can be discerned.

the fluid itself. Fluid expansion depends in turn on the impulse caused by hydrostatic pressure within the joint. Observing the results from our MRs we discovered that osteolytic lesions had not predominantly affected the supra-acetabular region, nor were the usual lesions surrounding acetabular screws frequent. Most cases exhibited a peripheral and continuous pattern; thus, lesion distribution seems to favor the production of a mass of osteolytic tissue in the joint which spreads "wherever it can", probably depending on the intra-articular hydrostatic pressure, as the effective joint space concept explains. At the femoral level, findings were more uniform and concordant. Osteolytic lesions were only detected at the two most proximal Gruen zones. No lysis was found at the bone-HA coating interface, as described in other studies. Likewise, no distal osteolysis was present with respect to the coated area, contrary to the evidence in femoral stems without HA circumferential coating. This is all in agreement with the possibility that, similarly to what occurs at the acetabular level, HA exerts a sealing effect which prevents the distal progression of synovial fluid and, therefore, the progression of osteolysis. This effect has already been described in other studies [35–39].

Abundant literature exists about the factors which influence the development of osteolysis [2,5,6,21,26,27,37,40]. In our series, we have confirmed that a more vertical acetabulum leads to a greater PE

Table 4
Correlation of Variables with Wear Rate and Number of Affected Areas.

	PE Wear Rate	
	Spearman's Correlation Coefficient	Sig. (2-Tailed)
Activity	0.325	0.004
Gait	0.288	0.012
Acetabular abduction (degrees)	0.283	0.014
	Number of Affected Areas	
	Spearman's Correlation Coefficient	Sig. (2-Tailed)
Wear rate (mm/year)	0.509	<0.001
Years of development	0.353	0.002
Gait	0.287	0.013
Acetabular abduction (degrees)	0.245	0.034
Activity	0.232	0.001
Age	−0.274	0.018

Table 5
Linear Regression Test for Wear Rate and Number of Affected Areas.

PE wear rate	Standardized Coefficients Beta	t	Sig (*P*).
Activity	0.375	3.452	0.001
Number of affected areas	**Standardized Coefficients Beta**	**t**	**Sig (*P*).**
Wear rate (mm/year)	0.399	4.147	0.000
Years of development	0.304	3.244	0.002
Age	−0.238	−2.494	0.015

wear, and thus it is more associated to osteolysis. Due to a purely biomechanical issue, younger patients undergoing surgery (who, accordingly, are more physically active) develop a greater PE wear, since the liner is subjected to more friction. These variables are also associated to greater osteolysis, which may be due to the effect of age and physical activity on PE wear, or to its direct implication in the development of the disease. The influence of age or activity on osteolysis could be explained, according to the effective joint space theory, because changes in hydrostatic pressure, impacts, and hip mobility would facilitate the expansion of debris-filled fluid.

Implant-dependent variables do exist. It has been described how cemented implants show a greater incidence of osteolysis than noncemented ones, and the growth pattern of the former is mostly linear, as opposed to the expansive nature of the latter [23]. Furthermore, in noncemented implants, a breach in the continuity of the coating or the HA coating may pose a greater risk of osteolysis and implant loosening [36,41,42]. It has not been proved that bigger-sized heads are linked to less osteolysis; quite the contrary: some works confirm that a greater diameter implies more wear and thus, more osteolysis [23,43]. In the case of PE, it is clear that the new PEs in the market and improvements in density, oxidation, etc. are allowing for a longer survival of the PE. The molecular weight of PEs has been increasing up to the ultra-high-molecular-weight (UHMW) PEs, which strengthens their durability. Molecular crosslinking (highly crosslinked PEs, HXLPE) and the improvements in sterilization procedures allow the most recent versions of this friction torque to endure wear much better, thus generating less osteolysis [5,43–45]. To ensure homogeneity in the series, we employed implants with same-generation PE (UHMWPE sterilized with gamma radiation), so we cannot present any conclusions regarding versions. It would be of interest to repeat this study with more current metal-PE friction torques, compare the results of both studies and draw conclusions.

The relevance of screws in facilitating the extension of osteolysis is still a controversial topic. Some studies support the theory that they indeed facilitate the extension, and that the presence of holes on the surface of the acetabular component seems to favor the appearance of cavitary lesions around them, whereas in the absence of acetabular holes, the most frequently described patterns are peripheral and continuous [21–23,46]. Other authors consider instead that the presence or absence of holes makes no difference [47]. The absence of any relation between osteolytic lesions and acetabular screws in our series leads us to believe that limiting the use of screws is not that important. What is important, though, in order to avoid the manifestation of osteolysis is to limit whichever factors contribute to the production of wear particles [40]. On the other hand, even though our series features perforated implants, growth patterns were predominantly peripheral. We believe this may have to do with the barrier effect HA exerts, as described by some authors [22,37,48].

Finally, our study confirms the absence of clinical signs and the limited diagnostic capacity of simple radiography even when external lesions are present, which complicates the decision to proceed with surgery. We are of the opinion that the cost-effectiveness of periodic clinical and radiographic revisions of THAs and the convenience of replacing them with other studies, which may tackle the problem of osteolysis in a more conclusive way, should be reconsidered. It is possible that in the case of clinically asymptomatic THAs, performing an MR after 5 years would be the most advisable recommendation from the cost-effectiveness perspective, although this alternative is still being discussed in the literature [12,17,33].

This study presents some limitations. Firstly, ours is a small series of consecutive cases studied retrospectively. The availability of the studied diagnostic type performed justifies these features. Secondly, case selection was not randomized, since the series comprises patients with high suspicion and incidence of osteolysis. Thus, the results of this patient series may not be extrapolated to less restricted populations. Furthermore, this is a cross-sectional, descriptive study. The lack of an evolutive follow-up, coupled with non-randomization,

Table 6
ANOVA Test for Lesion Type and Extent of Continuity.

Type of Lesion		N	Mean	SD	*P*
Number of affected areas	Totally central	2	1.50	0.707	0.000
	Totally peripheral	32	3.34	1.537	
	Mixed, predominantly central	4	1.25	0.957	
	Mixed, predominantly peripheral	16	2.63	1.025	
Wear rate (mm/year)	Totally central	2	0.06778	0.017285	0.024
	Totally peripheral	32	0.14476	0.073146	
	Mixed, predominantly central	4	0.13806	0.095789	
	Mixed, predominantly peripheral	16	0.12953	0.057530	
Acetabular abduction (degrees)	Totally central	2	47.00	5.657	0.017
	Totally peripheral	32	47.72	7.788	
	Mixed, predominantly central	4	59.25	13.500	
	Mixed, predominantly peripheral	16	49.19	11.107	
Years of development	Totally central	2	12.00	8.485	0.000
	Totally peripheral	32	14.06	2.951	
	Mixed, predominantly central	4	13.75	3.500	
	Mixed, predominantly peripheral	16	16.19	1.328	
Granuloma Continuity					
Number of affected areas	Complete	37	2.97	1.771	0.000
	Some isolated lesions	19	2.42	1.121	
	Isolated lesion predominance	5	1.20	0.837	
Years of development	Complete	37	13.97	3.087	0.002
	Some isolated lesions	19	15.53	1.837	
	Isolated lesion predominance	5	12.40	5.367	

precludes the working hypothesis approach. Another limitation is the fact we do not have any proper method to differentiate between the osteolytic lesions found and any potential preoperative arthritis-related cystic lesions. Even though the ideal scenario would be to have a preoperative MRI study, this was not possible. Hence, those cases in which preoperative cystic lesions were found either via previous imaging studies or intra-operatively were excluded. Lastly, the study design and its aims make this a mostly descriptive study which analyzes osteolysis patterns and their causes, but we did not mean to propose any hypothesis regarding the clinical sequelae of osteolysis and the aforementioned patterns. Undoubtedly, it would be very interesting and relevant to do additional research in this field, and our group will certainly work on this in the future.

Once the study was finished, we succeeded in our aims: in our series, osteolysis exhibited a high prevalence, and lesions were located in those regions the synovial fluid reached, following a peripheral, continuous progression which is in keeping with the concept of effective joint space. When analyzing which factors have an impact on the extent of osteolysis, we found it depends on PE wear rate, and both the extent and the wear rate are directly related with variables such as age, physical activity, the patient's walking capacity and the abduction of the acetabular component. These factors also determine the type of lesion growth, usually associated to continuous-peripheral patterns. Regarding the implant, it appears that noncemented, multiple-hole, HA-coated prostheses as those used in our series also favor continuous and peripheral patterns. Finally, it would seem that screw holes with screws inserted are not associated with a higher degree of acetabular osteolysis. Whenever osteolysis does occur at these sites, it is usually in the form of isolated, central lesions.

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