

MAGNETIC RESONANCE ARTHROGRAPHIC FINDINGS IN SUBJECTS WITH ACETABULAR LABRAL TEARS

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ABSTRACT

Objective: To describe the MR arthrographic findings in subjects with suspected acetabular labral tears of the hip. **Method:** 108 hip MRa results were analyzed in 2007-2008. Two radiologists independently interpreted the images, and the consensual answers between them were considered for analysis. Based on their opinions, information was obtained on the location, staging of the chondral and labral lesions, anatomic alterations, and the presence of trochanteric bursitis and tendonitis. **Results:** 1st degree labral lesions occurred in 41% of cases, 2nd degree in 31%, and 3rd degree in 29%. The cam type FAI was common in 36% of cases, pincer FAI in 11%, and

mixed cam-pincer FAI in 13%; in these cases 57% had grade III labral lesions. 1st degree chondral lesions were observed in 51% of acetabulum, 2nd degree in 13%, and 3rd degree in 18%. **Conclusion:** The morphologic alterations that cause cam type FAI were the most common. With respect to the degree of labral and chondral lesions, 1st degree lesions were the most common, irrespective of the presence or type of FAI, except in mixed cam-pincer FAIs, in which 3rd degree lesions were predominant. No relationship was observed between the degree of labral and chondral lesion.

Keywords: Arthrography. Epidemiology. Hip.

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INTRODUCTION

The acetabular labrum is a fibrocartilaginous structure fixed to the acetabular rim that plays an important role in hip stability. The labrum is responsible for increasing articular congruity and improving the distribution of loads between the femoral head and the acetabulum.^{1,2}

Labral tears are causes of incapacitating chronic pain, of an insidious kind, and generally of microtraumatic nature associated with structural abnormalities of the hip.¹ With the high accuracy of magnetic resonance arthrography (MRA) for the detection and staging of labral and chondral lesions,³⁻⁵ as well as that of anatomical alterations of the hip, there has been an improvement in the understanding of the clinical picture and of the pathomechanics of labral tears.

Alterations in the anatomical relationship between femur and acetabulum are the main etiological factors for the labral tear as they provoke femoroacetabular impingement (FAI). This impingement can be of the cam type, where there is loss of normal spherical junction between the femoral head and neck,^{1,6-8} or of the pincer type brought about by the enlargement of acetabular cover resulting from deep acetabulum

(coxa profunda) or acetabular retroversion.^{7,8} Less frequent, hip dysplasia provokes instability and consequently excessive anterosuperior displacement of the femur, which generates chronic trauma on the labrum, causing its degeneration.^{1,9} The different etiological factors can, however, provoke labral lesions with inherent morphologic characteristics and that occur in specific portions of the labrum.⁹⁻¹¹ Nevertheless, both anatomical alterations and labral tears appear to increase the pressures of articular contact of the hip and to provoke instability, predisposing the development of hip osteoarthritis.^{1,12-14} Therefore the aim of this study is to describe the MRA findings in subjects with acetabular labrum tears.

MATERIAL AND METHOD

Subjects

During the period from January 2007 to September 2008, 108 MRA exams were performed on 96 patients seen by an orthopedist, with suspicion of labral tear by means of McCarthy's clinical sign positive on physical examination and complaints of pain in the inguinal region. The imaging exams were performed at Clínica Imagem Centro Diagnóstico, Florianópolis/

All the authors declare that there is no potential conflict of interest referring to this article.

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Study conducted at Clínica Imagem Centro Diagnóstico – Florianópolis, SC, Brazil.

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Santa Catarina. There were 37 male patients (mean age 39.3 years; ranging from 18 to 63 years) and 56 female patients (mean age 41.3 years; ranging from 20 to 73 years).

MRA Arthro

All the examinations were executed using *MRI Gioscan T5 0.5T*[®] (Phillips, Netherlands) or *MRI Eclipse 1.5T*[®] (Picker, USA) equipment, using flexible coils dedicated to the joint.

The MRA examination protocol included axial spin-echo and coronal sequences T1-weighted, with TR/TE parameters of 500-625/12-15, as well as axial, coronal and sagittal sequences, DP-weighted (density of protons) with fat saturation and STIR (inversion recovery), with TR/TE parameters of 2500-3500/ 40-45. The matrix used was 256 x 256, with field of view (fov) between 23 and 30cm. Number of excitations (nex) of 1 or 2.

In the MRA examinations there was preparation with a protocol of intra-articular injection of a solution composed of 0.02ml of paramagnetic contrast medium (gadolinium), 4.0ml of nonionic iodinated contrast medium and 3.0ml of 0.5% bupivacaine, without vasoconstrictor, diluted in 10.0ml of 0.9% sterile saline solution. In all the cases access was through an anterior portal at the level of the femoral neck, with a fine needle (22G), monitored by radioscopy.

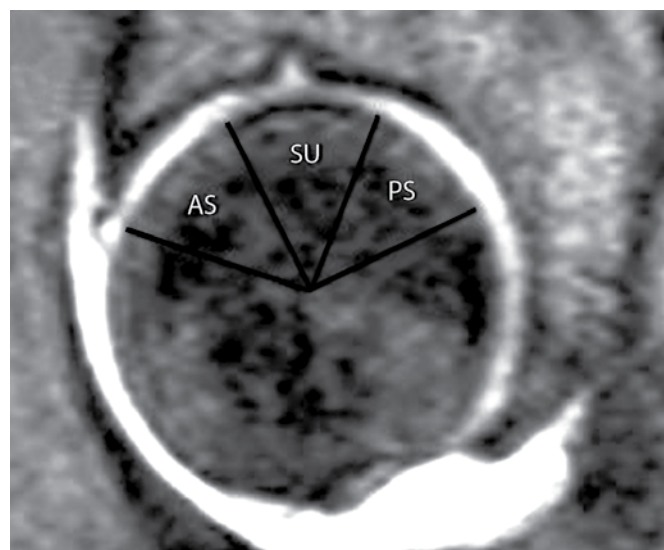
Interpretation of images

The images were analyzed prospectively by two radiologists with more than 8 years of experience in musculoskeletal radiology. Sequences of images of the sagittal plane were used for analysis of the location of the labral tear and of the acetabular cartilage. The acetabular weight-bearing area was divided into three portions, according to Nishii *et al.*:¹⁵ anterosuperior (AS), superior (SU) and posterosuperior (PS). (Figure 1)

The classification system described by Czerny *et al.*³ was used to assess the degree of labral lesion, not considering subdivisions A and B. In the absence of a tear, or Zero Degree, the labrum has low and homogeneous signal intensity, a triangular shape, and continuous fixation to the acetabular rim without the existence of a cut or furrow. In the 1st Degree the acetabular labrum exhibits an increase of signal intensity extending to the labral margin, maintenance of the triangular shape and continuous fixation to the acetabular rim without the existence of cut or furrow. In the 2nd Degree there is extension of the contrast medium into the labrum, but without deinsertion of the acetabular rim, not taking into consideration any thickening or the presence or not of labral recess. In 3rd Degree lesions there is thickening and labral deinsertion.

The following parameters were used for classification of the degree of degeneration of the acetabular cartilage: Zero Degree, signal intensity normal without chondral surface irregularities. 1st Degree, increase of signal intensity between the low signal of the fibrocartilage and the intermediate signal of the hyaline articular cartilage, with minor surface irregularity. 2nd Degree, chondral erosion or separation immediately adjacent to the labral fixation. 3rd Degree, total loss of cartilage thickness with areas of subchondral bone exposure.

The staging of the degree of labral and chondral lesion was performed through the description in reports from both radiologists.



AS – anterosuperior; SU – superior; PS – posterosuperior.

Figure 1. MRA sagittal plane: division of the weight-bearing zone of the hip.

Statistical analysis

The statistical analysis was conducted by means of a descriptive analysis of the data.

RESULTS

Of the 108 hips analyzed it was observed that in 42 (39%) hips there were no signs of any kind of anatomical alteration such as dysplasia and FAIs. Cam FAI was verified in 39 (36%) hips, with pincer FAI in 12 (11%) hips and both types of FAI (called mixed here) in 14 (13%). In the male patients cam FAI occurred in 29 (67%) hips, while in the female patients the absence of FAI occurred in 35 (54%) hips. (Figure 2) Of the individuals with pincer FAI, 10 are female and 2 male.

Of the causes of pincer FAI, acetabular retroversion was evidenced in 21 (19%) and deep acetabulum in 5 (5%) of the 108 hips. They were observed together in only one case. (Case 75, Table 1)

Shallow acetabulum was observed in only 2 (2%) hips. (Case 60 and 66, Table 1)

In 24 hips the tear occurred in only one portion of the acetabular labrum. The AS portion was affected in 59 (40%) hips, the SU portion in 38 (26%), the PS in 5 (3%), and the labrum was completely torn in 45 (31%) hips. In the female patients, 40% (n = 39) of the tears occurred in the entire labral portion, while in the male patients, the most severely affected portion was the AS part in 42% (n = 25) of the cases. Of the hips with cam FAI, 14 (36%) has AS and SU labral tears, 13 (33%) had tears affecting the entire labrum, 8 (21%) only in the AS portion, 2 (5%) in the SU portion, and 2 (5%) in the AS and PS portions of the labrum. In the cases with pincer FAI, 6 (50%) presented total lesion of the labrum, 3 (25%) in the AS and SU portion, 2 (17%) in the AS portion, and 1 (8%) only in the PS part. In mixed FAI 7 (50%) had total lesion of the labrum, 6 (46%) in the AS and SU portion of the labrum, and 1 (7%) just in the AS portion.

Table 1. Data on the cases of labral lesion.

Case	Gender/Age	Limb	Degree of labral lesion			Degree of acetabular chondral lesion			FAI
			AS	SU	PS	AS	SU	PS	
1	F33	R	3	1	0	0	0	0	Cam/pincer
2	F42	L	2	1	1	1	1	1	No
3	F42	R	2	2	0	1	1	1	No
4	M18	L	0	1	0	0	0	0	Cam
5	F33	R	3	3	3	2	2	2	Cam/pincer
6	F47	L	3	0	0	2	0	0	Cam/pincer
7	F46	L	2	2	1	3	2	2	No
8	F38	L	3	2	0	0	1	0	Cam/pincer
9	F46	R	2	2	1	1	1	1	No
10	F48	L	1	1	1	1	1	1	Cam
11	F54	L	1	1	1	1	0	0	Pincer
12	F54	R	1	1	1	1	1	1	No
13	F52	L	2	0	0	1	1	1	No
		R	2	1	1	1	1	1	No
14	F56	R	2	0	0	1	1	1	No
15	F49	L	3	1	1	3	1	1	Pincer
16	F53	L	3	1	1	1	0	0	No
17	F50	R	3	3	3	1	1	1	No
18	M35	R	2	1	1	1	1	1	Cam
19	F37	L	3	2	0	1	1	0	Pincer
20	F29	L	1	1	0	1	1	0	Cam
21	F37	R	1	1	1	3	1	1	No
22	F33	L	1	1	1	3	1	1	No
23	F36	L	3	3	0	0	0	0	No
24	F34	L	1	1	1	1	1	1	No
25	F37	L	1	1	1	1	0	0	Cam
26	F29	L	1	1	0	1	1	0	Pincer
		R	1	1	0	3	1	0	Pincer
27	F42	R	2	0	0	1	0	0	Cam
28	F45	L	3	0	0	0	0	0	Pincer
		R	3	0	0	0	0	0	Pincer
29	M22	L	3	3	3	1	0	0	Pincer
30	M25	L	1	1	1	0	0	0	Cam/pincer
31	M26	L	2	0	0	0	0	0	Cam
32	M35	L	1	0	1	1	1	1	Cam
		R	1	0	2	1	1	1	Cam
33	M36	L	2	2	1	3	1	1	Cam
34	M35	L	1	1	1	3	2	2	Cam
		R	1	1	1	2	2	2	Cam
35	M29	L	1	1	0	2	2	0	Cam/pincer
36	M36	R	2	2	0	1	1	1	Cam
37	M36	R	2	0	0	0	0	0	No
38	M37	L	1	1	1	2	3	2	Cam
39	M34	R	2	2	0	3	0	0	No
40	M40	R	2	2	0	1	1	1	Cam
41	M32	R	1	0	2	1	1	1	No
42	M34	L	1	1	1	3	2	2	No
43	M38	L	2	0	0	1	1	1	Cam
44	M43	L	3	3	3	1	1	0	Cam
		R	3	3	3	1	1	0	Cam
45	M45	R	2	0	0	2	2	2	Cam
46	M42	L	1	1	0	2	2	0	No
47	M45	L	1	1	0	1	1	0	Cam
48	M39	L	3	0	0	0	0	0	Cam
49	M41	R	1	1	0	0	0	0	Cam
50	M54	R	2	1	2	1	1	1	Cam
51	M49	R	1	1	1	1	0	0	Pincer
52	M54	R	1	0	0	1	0	0	Cam
53	M64	L	1	1	1	3	3	3	Cam
54	M62	L	3	2	0	0	1	0	Cam
55	M63	R	3	3	3	1	1	1	Cam
56	F25	R	3	3	0	3	0	0	No
57	F26	R	3	1	0	1	0	0	No
58	F20	L	2	0	0	0	0	0	No
59	F21	R	0	0	1	0	0	0	Pincer
60	F20	R	3	0	0	1	0	0	Cam

Case	Gender/Age	Limb	Degree of labral lesion			Degree of acetabular chondral lesion			FAI
			AS	SU	PS	AS	SU	PS	
61	F21	L	3	3	1	1	0	0	No
		R	3	3	0	1	0	0	No
62	F59	R	2	2	0	1	3	1	Cam/pincer
63	F64	L	1	1	1	3	3	0	No
64	F59	L	2	0	0	1	1	1	No
65	F63	L	2	2	1	2	3	2	Cam/pincer
66	F47	R	2	2	1	2	3	0	No
67	F20	R	1	1	1	0	1	0	Pincer
68	M22	L	3	2	1	1	0	0	Cam/pincer
		R	3	2	2	1	0	0	Cam/pincer
69	M35	L	2	0	0	0	1	0	No
		R	1	0	0	0	0	0	No
70	F43	L	1	1	0	1	0	0	No
		R	1	1	0	1	0	0	No
71	F46	L	1	1	0	1	1	1	Cam/pincer
72	F46	L	2	2	0	1	0	0	No
73	F39	R	1	0	0	0	0	0	Cam
74	F44	R	1	1	0	2	2	2	No
75	F25	R	3	3	3	1	1	0	Cam/pincer
76	F24	L	1	1	1	2	2	2	No
77	F29	L	1	1	1	2	1	1	No
78	F31	R	3	3	3	2	3	2	Pincer
79	F52	L	3	3	1	2	0	0	No
		R	3	3	0	2	0	0	No
80	F34	R	1	1	0	1	1	0	Cam
81	M29	R	2	0	1	1	1	1	No
82	F27	L	1	1	0	0	0	0	No
83	F45	R	1	0	0	2	2	2	No
84	F28	R	1	1	0	1	1	0	No
85	F55	L	1	1	0	1	1	0	Cam
86	F73	R	3	3	2	3	3	3	Cam/pincer
87	F62	R	0	2	0	0	2	0	No
88	M42	L	1	2	0	0	0	0	No
89	M49	R	3	1	0	1	0	0	Cam
90	M53	L	1	1	0	3	2	0	Cam
91	F51	R	2	1	0	1	1	1	No
92	M24	L	1	2	0	0	0	0	Cam
		R	0	2	0	0	0	0	Cam
93	M61	L	1	1	0	1	1	1	Cam
94	F22	R	1	0	0	0	0	0	No
95	F56	L	1	1	0	0	0	0	No
96	F58	R	2	1	1	2	2	2	Cam/pincer

Caption: M – male; F – female; AS – anterosuperior; SU – superior; PS – posterosuperior

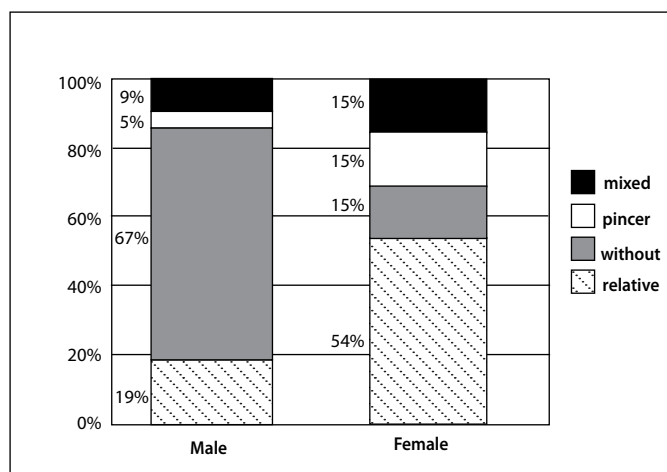


Figura 2. Relative frequency of FAI in relation to gender.

In relation to the staging of labral tears, it was observed that 1st degree lesions occurred in 44 (41%) hips, 2nd degree lesions in 33 (31%), and 3rd degree lesions in 31 (29%)

hips. In the female patients 1st degree lesions were the most prevalent, observed in 27 (42%) hips. In the male patients 1st and 2nd degree lesions had equal frequencies of 40% each, that is, 17 hips for each degree. Analyzing just 3rd degree lesions, these were more frequent in women (71%; n = 22) than in men (29%; n = 9). Of the subjects with cam type FAI, 20 (51%) had 1st degree labral lesion, 12 (31%) 2nd degree lesion and 7 (18%) 3rd degree lesion. Of the individuals with pincer type FAI, 6 (50%) presented 1st degree labral lesion and 6 (50%) 3rd degree lesion. No case presented 2nd degree labral lesion. In the cases with mixed FAI, 8 (57%) presented 3rd degree labral lesion, and 1st and 2nd degree lesions represented 3 (21%) hips each. In the hips without FAI, 15 (35%) presented 1st degree labral lesion, 18 (42%) 2nd degree lesion and 10 (23%) 3rd degree lesion. (Figure 3) The degree of labral lesion by portion of the labrum is described in Table 1.

In relation to chondral lesions, these occurred in 88 (81%) acetabula and were absent in 20 (19%). In 46 (44%) hips chondral lesions were observed in the entire weight-bearing zone, in 36 (35%) acetabula just in the AS portion, in 22 (21%) in the SU

portion, and no lesion was observed only in the PS portion of the weight-bearing zone.

First degree chondral lesion was observed in 55 (51%) acetabula, 2nd degree lesions in 14 (13%), and 3rd degree lesions in 19 (18%). In relation to the degree of lesion of the acetabula

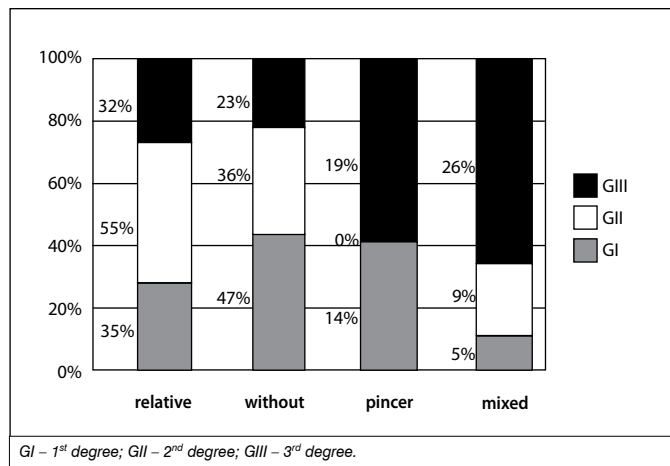


Figure 3. Relative frequency of the degree of labral lesion in relation to the type of FAI.

bulbar cartilage in individuals with cam FAI, 24 (62%) acetabula had 1st degree chondral lesion, 6 (15%) had acetabula with 3rd degree lesion, 2 (5%) had 2nd degree lesion and 7 (18%) degree 0. In the acetabula with pincer FAI, 6 (50%) presented 1st degree chondral lesion, 3 (25%) hips had 3rd degree lesion, 3 (25%) hips exhibited zero degree, and no 2nd degree chondral lesion was observed in any acetabulum. In subjects with mixed FAI, 5 (36%) acetabula had 1st degree chondral lesion, 4 (29%) acetabula had 2nd degree lesion, and 3 (21%) hips had 3rd degree lesion. In 2 (14%) acetabula there was no chondral lesion. (Figure 4) The degree of chondral lesion by acetabular portion is described in Table 1.

No relationship was observed between the degree of labral lesion and the degree of acetabular chondral lesion. (Table 2) Tendinitis of the gluteal muscles was present in 27 (25%) hips. Of these, 23 (85%) occurred in the female gender.

The frequency of trochanteric bursitis was 28 (26%) cases. Of these, 25 (89%) were evidenced in the female gender.

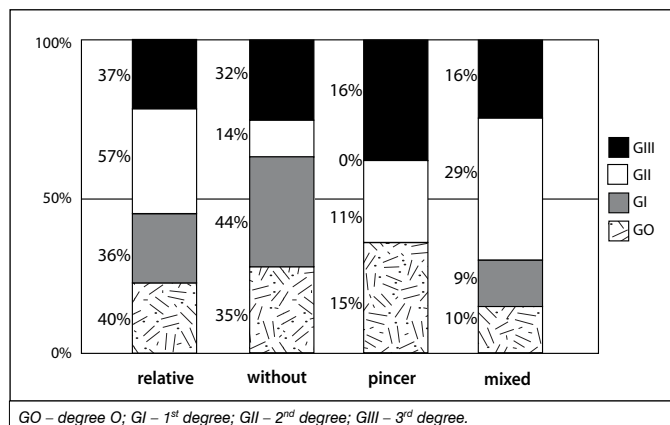


Figure 4. Relative frequency of the degree of acetabular chondral lesion in relation to the type of FAI.

Table 2. Relationship between the degree of labral lesion and degree of acetabular chondral lesion.

Degree of lesion	Degree of acetabular chondral lesion				
	Labral	Degree 0	1st Degree	2nd Degree	3rd Degree
1st Degree	9 (20%)	19 (43%)	7 (16%)	9 (20%)	44 (100%)
2nd Degree	6 (18%)	18 (55%)	3 (9%)	6 (18%)	33 (100%)
3rd Degree	5 (16%)	18 (58%)	4 (13%)	4 (13%)	31 (100%)
Total	20 (19%)	55 (51%)	14 (13%)	19 (18%)	108 (100%)

DISCUSSION

Labral lesions caused by anatomical alterations such as FAIs and dysplasia occurred in 61% of the hips, and in 39% there were no signs of any alteration with the MRA. FAIs of the pincer and mixed type occurred in only 23% of the hips and the greatest prevalence of pincer FAI occurred in women. Among the morphological alterations that cause pincer FAI, acetabular retroversion was more prevalent than deep acetabulum. Cam FAIs were the most prevalent and in 67% of the cases affected male patients, which is in accordance with the studies of Ito *et al.*,⁶ Beck *et al.*⁹ and Ganz *et al.*¹².

Labral lesions without an apparent etiologic factor shown by MRA may be related to biomechanical factors that increase for adduction and internal rotation of the femur such as, for example, hindfoot varus, valgus knee, discrepancies of lower limb length, femoral retroversion¹⁶ or trauma.⁸

However, the morphological differences of the hip may be related to labral lesions with specific characteristics. Our study demonstrated that most labral lesions occur in the AS portion of the labrum and corresponds to the literature,^{3,4,9,13,14,17,18} although we observed a high frequency (31%) of total lesion of the labrum, mainly in female patients. According to Lewis and Sahrman,¹⁹ the prevalence of AS lesions is due to the fact that this region is subject to high forces directed previously and the mechanical weakness of this region.

According to Beck *et al.*⁹ and Pfirmann *et al.*¹⁴, in hips with cam FAI labral lesions occur mostly in the AS portion due to the loss of anterior sphericity of the femoral head. This does not occur in cases of pincer FIA where the lesions tend to be more distributed, yet with predominance in the SU portion.⁹ Our findings are consistent with these authors. However, we emphasize that there was a high frequency (33%) of total labral lesion in hips with cam FAI and in two cases in the AS and PS portions. In hips of the mixed type, we observed a greater incidence of lesions in the entire portion of the labrum (50%).

In relation to the staging of labral lesions, we observed greater frequency of 1st degree lesions, followed by 2nd and 3rd degree lesions. In literature there is considerable variation concerning the degree of greater incidence. Czerny *et al.*³ observed the same order with 24 1st degree labral lesions, 19 2nd degree lesions and 8 3rd degree lesions. However in a subsequent study, Czerny *et al.*⁴ evidenced 24 3rd degree labral lesions, 7 2nd degree lesions and 4 1st degree lesions. Now Blankenbaker *et al.*¹⁸ observed 42 cases of 2nd degree labral lesions and 23 of 3rd degree lesions, with no case of 1st degree labral lesion.

Both the labral lesions and FAI and hip dysplasia are possible etiologic factors for hip osteoarthritis.^{1,3,12} It is believed that

the labral lesion doubles the risk of chondral lesion.¹ Accordingly, studies by videoarthroscopy and MRA have reported an association between labral and chondral lesion that varies from 52.7%⁵ to 73%.¹ In subjects with FAI, however, chondral lesions were present in 88%²⁰ and 95%.⁷ In our study acetabular chondral lesions were present in 81% of the hips with labral lesion. Chondral lesions are normally adjacent to labral lesions and mostly occur in the AS portion of the acetabulum.^{1,7,9,20} On the other hand, we observed that only 35% occurred in the AS portion alone and 44% in the entire acetabular weight-bearing zone.

In spite of the high association between labral and chondral lesions, the degree of chondral lesion is probably not related to the degree of labral lesion. Our findings demonstrated that even in cases of 2nd and 3rd degree labral lesions, the frequency of 1st degree acetabular chondral lesions was 55% and 58%, respectively. (Table 2) Surgically, Ito *et al.*²¹ evaluated the histopathological characteristics of the acetabular labrum and the morphological characteristics of the acetabular cartilage and did not observe a relationship between the characteristics of the labrum with the severity of the chondral lesion.

On the other side, anatomical bone conformation may be related to the degree of labral and chondral lesion. The anatomical alterations of the hips with cam FAI provoke extensive chondral lesion with subchondral bone exposure and labral deinsertion. However, chondral lesions tend to be more limited and of lesser severity in pincer type FAIs.^{9,12} James *et al.*¹³ evidenced focal points of bone exposure and labral deinsertion in 50% of the subjects with cam FAI. Our study observed that 51% of the subjects with cam FAI present 1st degree labral lesion, and only 23% with 3rd degree labral lesion. As regards chondral lesion, we observed that only 15% of the hips with cam FAI present 3rd degree lesion and 62% 1st degree lesion.

Tendonitis of the abductor muscles of the hip, specifically the gluteus medius, and trochanteric bursitis are responsible for

pain in the gluteal region and in the vicinity of the trochanter, caused by activities that require hip flexion such as in gait, descent of stairs, or in remaining seated. This clinical picture is similar to that observed in individuals with labral lesion, and therefore is seen as one of the differential diagnoses. Yet the association between these lesions is not reported in literature. In our findings tendonitis of the gluteal muscles was present in 27 (25%) hips, of which 85% occurred in the female patients. The frequency of trochanteric bursitis was 28 (26%) cases and in 89% they were evidenced in the female patients. This condition occurred in association with gluteal tendonitis in 18 hips. Our study presents as a limitation the lack of quantitative measurement concerning the hip morphology. In not all the cases was the α angle used to quantify the alteration of the femoral head-neck junction, with the Wiberg angle that describes the relationship of the femur and acetabulum, and angle of acetabular coverage. Another limiting factor is the subjectivity for the staging of the degree of labral lesion in view of the radiological technique employed.

CONCLUSION

We observed that the AS labral segment and all the cartilage from the acetabular weight-bearing zone were the most strongly affected portions. In cases of pincer FAI, lesions across the acetabular labrum were the most prevalent, while in cam FAI the AS portion had the most frequent lesions. In relation to the degree of labral and chondral lesion, 1st degree lesions were predominant regardless of the presence or of the type of FAI, except in mixed FAIs where 3rd degree labral lesions predominated. We did not observe a possible relationship between the degree of labral and chondral lesion. The frequency of acetabular retroversion, dysplasia, paralabral cysts, gluteal tendonitis and trochanteric bursitis was low.

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