Correlation of Clinical and MRI Findings in Hips of Elite Female Ballet Dancers

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ABSTRACT

Purpose: To understand why professional female ballet dancers often complain of inguinal pain and develop early hip osteoarthritis (OA). Goals were to examine clinical and advanced imaging findings in the hips of dancers when compared to a matched cohort of non-dancers; and to assess the femoral head translation in the forward split position using Magnetic Resonance Imaging (MRI).

Methods: Twenty professional female ballet dancers and fourteen active healthy female matched for age (control group) completed a questionnaire on hip pain, underwent hip examination with impingement tests and measurement of passive hip range of motion (ROM). All had a pelvic 1.5-T MRI in back-lying position to assess femoroacetabular morphology and lesions. For the dancers, additional MR images were acquired in split position to evaluate femoroacetabular congruency.

Results: 12 of 20 dancers complained of groin pain, only while dancing; controls were asymptomatic. Dancers' passive hip ROM was normal. No differences in α neck angle acetabular depth, acetabular version and femoral neck anteversion were found between dancers and controls. MRI of dancers while doing the splits showed a mean femoral head subluxation of 2.05 mm. MRI of dancers' hips showed labral tears, cartilage thinning, and herniation pits, located in superior and postero-superior positions. Lesions were the same for symptomatic and asymptomatic dancers. Controls had proportionally the same amount of labral lesions, but in antero-superior position. They also had 2 to 3 times less cartilage lesions and pits than dancers.

Conclusions: The results of our study are consistent with our hypothesis that repetitive extreme movements can cause femoral head subluxations and femoroacetabular abutments in female ballet dancers with normal hip morphology, which could result in early OA. Pathological changes seen on the MRI were symptomatic in less than two thirds of the dancers.

Level of Evidence: IV

INTRODUCTION

Ballet is a combination of sport and art. Professional ballet dancers use extreme hip range of motion (ROM), often beyond conventional physiologic limits, to achieve ideal ballet technique and aesthetic. Ballet movements and postures are based on the "turnout" position: the lower extremity is externally rotated, from the hip to the foot. Ideal turnout involves 55° to 70° of external rotation (ER) at the hip, 10° of ER at the knee, up to 12° of tibial torsion, and abduction of the forefoot at the midtarsal joint.[1] Most dancers do not achieve adequate turnout and compensate by increasing the lumbar lordosis, "screwing the knees", and/or rolling in of the foot, leading to the most common overuse injuries in dancing: lumbar stress fracture or spondylolisthesis[2], medial knee ligaments injuries[3], patellofemoral pain, and foot and great toe problems[4]. There is a high prevalence and incidence of lower extremity and back injuries, with soft tissue and overuse injuries predominating. Lifetime prevalence estimates for injury in professional ballet dancers range between 40% and 84%.[5] Hip problems form only 10% of ballet injuries in most published series.[6] However, many dancers complain of groin pain while dancing, mainly during dynamic movements implying extreme hip flexion and abduction combined with external rotation, such as "grand plié", "grand battement à la seconde" or "grand développé à la seconde" (Figure 1). Ballet dancers are known to present a higher risk of developing early hip osteoarthritis (OA).[7] Femoroacetabular impingement (FAI) has been shown to be a risk factor for early OA.[8,9] FAI is more commonly found in patients with abnormal acetabulum (retroverted, coxa profunda, protrusio) or with an abnormally shaped proximal femur (poor head-neck offset, posttraumatic deformities, slipped capital femoral epiphysis, femoral retrotorsion, coxa vara, femoral head necrosis with flattening). Two types of FAI have been described: the cam type FAI (femoral neck abnormality) and the pincer type FAI (acetabular rim abnormality).[10] Femoroacetabular abutment can also be found in patients with normal hip anatomy, but performing extreme hip ROM (e.g., ballet dancers, yoga practitioners).[11] This dynamic and activity-related femoroacetabular abutment could lead to early hip OA, but the exact mechanism has never been demonstrated. There is also the hypothesis that the femoral head subluxates in extreme positions, leading to increased cartilage stress and with time to OA.

The aims of the study were (1) to clinically evaluate professional female dancers' hips with measurement of the passive ROM, (2) to search for femoroacetabular lesions that might correlate the groin pain described by many dancers, (3) to investigate if femoroacetabular joint congruency is preserved while doing extreme movements such as in split position (i.e., when the dancer sits down on the floor with one leg straight forward and the other straight back, at right angles to the trunk) and (4) to correlate clinical findings to Magnetic Resonance Imaging (MRI) examination. Our hypothesis was that extreme movements may cause femoroacetabular abutments and femoral head subluxations, which could result in early OA in dancers with normal hip morphology.

Figure 1. Left: a ballet dancer in "grand plié" position. Right: "developpé à la seconde" position. "Grand battement à la seconde" is the same movement but dynamic. Those movements are a combination of flexion, abduction and external rotation of the hip.

MATERIALS AND METHODS

Study population and study design

Twenty female ballet dancers (mean age, 26 years; age range, 18-39 years) were recruited and fourteen active healthy female matched for age as a control group (mean age, 27 years; age range, 20-34 years). The dancers were either advanced students at higher schools of dance or professional dancers. They all performed ballet and contemporary dance. All had been dancing for more than 10 years and practiced for more than 12 hours per week. Exclusion criteria for the volunteers of both groups were hip injury, prior hip surgery, and any usual contraindication for MRI. The study was approved by the local ethics committee and the volunteers gave written informed consent.

Clinical evaluation

- ***Questionnaire***

Participants had to complete a questionnaire (Table 1) made by the authors about the presence (side, intensity) and localization of hip pain ("inguinal" for groin pain, "lateral" for pain around the greater trochanter, "buttock" for posterior pain), activities which triggered the pain, and evaluation of consecutive activity limitations (e.g., stairs climbing, sitting). The questionnaire also asked dancers about the chronological relation of the hip pain with their dancing activities.

- ***Physical examination***

Dancers underwent a complete physical examination of the hip with measurement of passive ROM in flexion/extension, abduction/adduction (back-lying with hip and knee in extension) and internal/external rotation (back-lying with hip and knee flexed at 90°). While one physician was holding position of the lower limb, a second one measured hip angles in those different positions with a hand held goniometer. Each measure was done twice to verify the repeatability of the measure, and it was a consensus exam. Care was taken to stabilize the pelvis during passive motion to prevent overestimation of hip range of motion. The results were correlated to the normal value for each movement according to Debrunner.[12]

Anterior impingement test was done for each volunteer, looking at elicited pain.[11] The test was done in supine position, with 90° to 120° of hip flexion and maximal adduction and internal rotation. When groin pain was elicited by anterior impingement test, the test was considered as positive. Posterior impingement test was done in supine position with hyper-extension and external rotation. When buttock pain was elicited by posterior impingement test, the test was considered as positive. Internal snapping hip was tested by passively taking the hip from a flexed/externally rotated position to an extended/internally rotated position. Other causes of groin pain such as adductor tendinopathy, symphisitis or sports hernia were controlled.

Radiological evaluation

MRI of the pelvis in supine position was performed with a 1.5-T system (Avanto; Siemens Medical Solutions, Erlangen, Germany) to assess femoroacetabular morphology and lesions in dancers and controls. For the dancers, additional images were acquired in split position to evaluate the hip joint in this extreme position (Figure 2).

Figure 2. A ballet dancer in split position before MR imaging.

Two musculoskeletal radiologists performed a consensus reading with two randomized patient's orders and without any information about the clinical evaluation.

- ***Morphology***

The morphology of both the femoral head and the acetabulum was measured on MRI for each volunteer according to radiographic criteria: acetabular depth[13], acetabular version[14] and femoral α neck angle.[15] The acetabular depth was evaluated according to the method detailed by Pfirrmann et al.[13] The depth was considered as positive and normal if the center of the femoral head (*O*) was lateral to the line connecting the anterior and posterior acetabular rim (Figure 3A). Measurement of the acetabular version was based on the angle between the sagittal direction and lines drawn between the anterior and posterior acetabular rim, at different heights (Figure 3B). The angle was considered as positive (anteversion) when inclined medially to the sagittal plane or negative (retroversion) when inclined laterally to the sagittal plane. The α neck angle was measured in accordance with the method described by Notzli et al.[15] in eight positions (1: anterior, 2: anterosuperior, 3: superior, 4: posterosuperior, 5: posterior, 6: posteroinferior, 7: inferior, 8: anteroinferior) around the femoral neck (Figure 3C,D). Deviation from the normal geometry was associated with α angles larger than 55°.

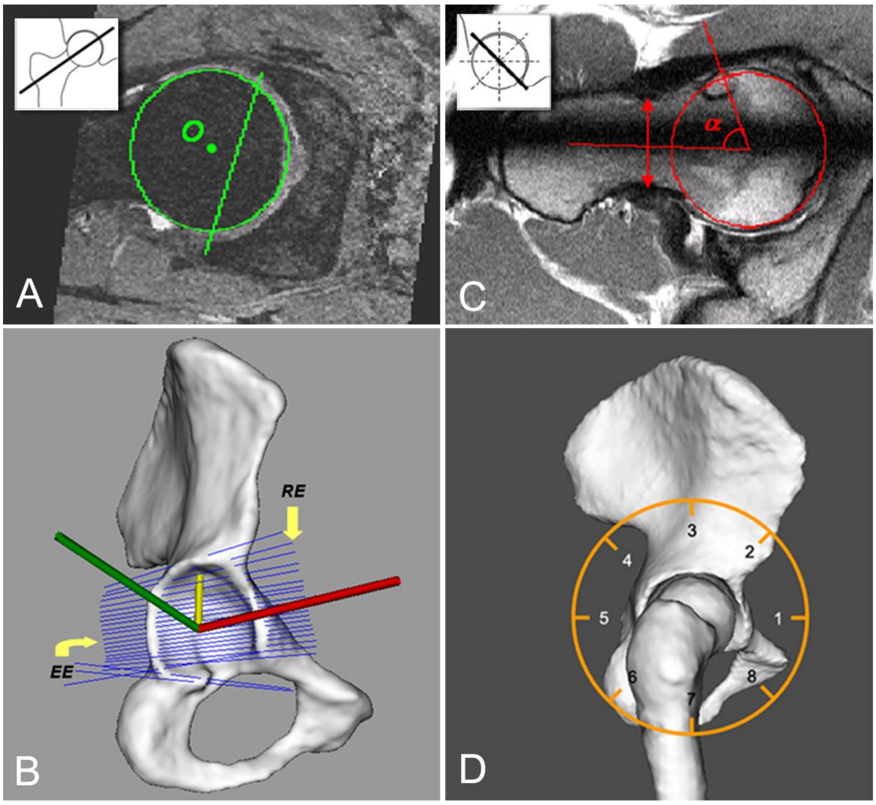

Figure 3. A) Definition of the acetabular depth on a transverse oblique MR image obtained through the center of the femoral neck according to Pfirmann et al.[13] B) Computation of the acetabular version: roof edge (*RE*) and equatorial edge (*EE*) are lines drawn between the anterior and posterior acetabular edges, defining the orientation of the acetabular opening proximally and at the maximum diameter of the femoral head respectively (arrows). C) Definition of the α angle on a radial MR image according to Notzli et al.[15] illustrating a cam type morphology (α = 85°). D) Acetabulum divided into 8 sectors (1:anterior, 2:anterosuperior, 3:superior, 4:posterosuperior, 5:posterior, 6:posteroinferior, 7:inferior, 8:anteroinferior) where α angles were measured. The sectors were also used to document locations of labrum and cartilage abnormalities.

In addition to those cam/pincer indicators, 2 measurements were performed to verify the presence of any other morphological features: femoral neck-shaft angle (Figure 4A) and neck anteversion defined in the axial plane by superimposing MR images taken at different heights (Figure 4B).

- ***Pathology***

For each subject, labrum and cartilage abnormalities were assessed qualitatively at eight positions, as depicted in Figure 3D. Acetabular cartilage was considered as normal (grade 0), hyperintense (grade 1), thinning (grade 2), tear (grade 3), flap (grade 4), or hyposignal (grade 5), and extent of cartilage damage was documented. The acetabular labrum was considered as normal (grade 0), degenerated (abnormal signal intensity, grade 1), torn (abnormal linear intensity extending to the labral surface, grade 2), as ossification of the labrum (continuity of the labrum with acetabular bone marrow, grade 3), or as a separated ossicle (os acetabuli, grade 4). The presence of subchondral acetabular or femoral bony abnormalities (e.g., edema, cysts) and the presence of a herniation pit (a round cystic lesion at the anterior aspect of the femoral neck) were also reported.[10]

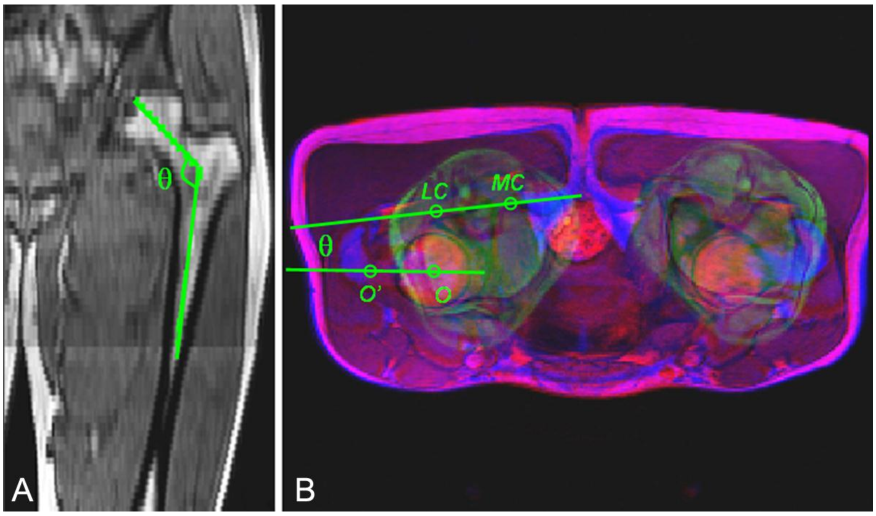

Figure 4. A) Computation of the neck-shaft angle on a frontal MR image. B) Definition of the femoral neck anteversion, defined by the angle formed by the line *O-O'* connecting the center of the femoral head (*O*) and the center of the femoral neck (*O'*) at its narrowest point, and the line *MC-LC* connecting the medial condyle (*MC*) and the lateral condyle (*LC*). This angle is calculated in the axial plane by superimposing MR images taken at different heights.

- ***Femoroacetabular congruency***

Dancers underwent MRI in split position to evaluate congruency of the hip joint in such extreme position. Femoral head subluxation was evaluated by the method described by Gilles et al.[16] The method is based on a surface registration technique and required the following procedure (Figure 5): first, a virtual 3D model of the hip joint is reconstructed using the MR images in supine position, thanks to a validated segmentation software.[17,18] Thus, for each dancer, patient-specific 3D models of the pelvis and femur were obtained. Second, the hip joint center (HJC) position is estimated in this reference neutral posture. Third, the 3D bony models are registered to extract joint poses from MR images in split position. Finally, femoroacetabular translations are measured with reference to the previously estimated HJC. The interested reader can refer to the article for more details.[16]

Statistical analysis

A statistical analysis was conducted to compare dancers' hip morphology to controls. Alpha neck angles measured in eight positions were compared. Acetabular depth, acetabular version, femoral neck anteversion and femoral neck-shaft angle were also compared between the two groups. For all comparisons, p-values were calculated with the Mann-Whitney U test and were considered as statistically significant if < 0.05.

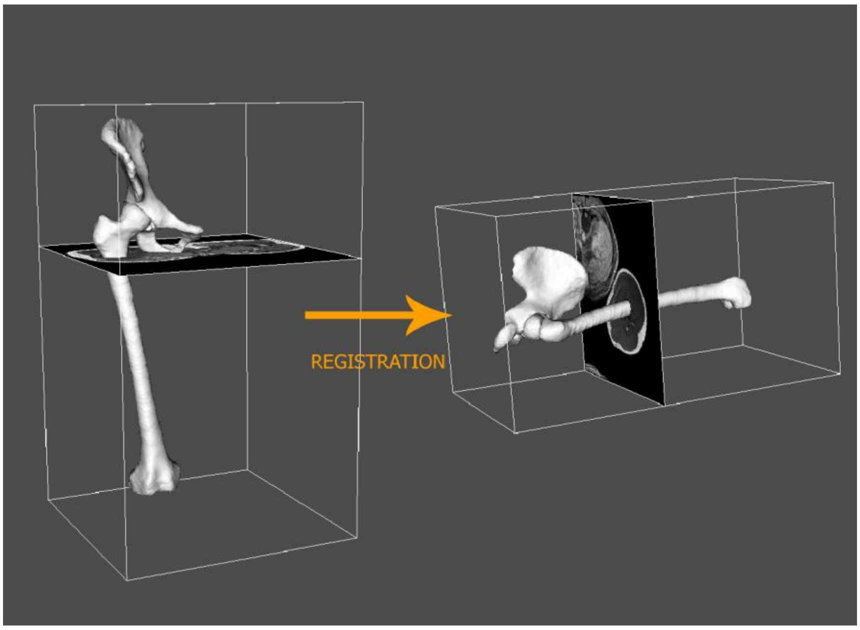

Figure 5. A virtual 3D model of the hip joint is reconstructed using the MR images in supine position (reference neutral posture, left). The HJC is estimated in this position. The 3D models are registered to extract joint poses from MR images in split position (right). Femoroacetabular translations are then measured with reference to the previously estimated HJC.

RESULTS

Clinical results

- ***Questionnaire***

The results of the questionnaire for each dancer are listed in Table 2. Twelve out of 20 dancers complained of hip pain: 4 bilaterally, 7 on the right hip and 1 on the left hip. Pain was inguinal and occurred only while dancing, mainly at the end of the ROM of specific dancing movements, such as "grand battement à la seconde", "grand plié" and "développé à la seconde". It is worth mentioning that all these movements imply extreme abduction and flexion combined with external rotation of the hip. Dancers had no pain and no limitations during daily living (such as while sitting, squatting, crossing legs, sleeping, climbing stairs, etc.). Control group was asymptomatic.

- ***Physical examination***

The results of the dancers' passive hip ROM are listed in Table 3, with the normal ROM taken as reference.[12] The dancers had normal passive hip ROM, with a trend to increased abduction and external rotation (50% were over the normal range), and to decreased internal rotation (30% were below the normal range). Pain could be reproduced by the anterior impingement test for 7 out of 20 dancers (bilateral for 2 dancers). Posterior impingement test was positive for 3 dancers (unilateral). Internal snapping hip was present in 2 dancers (unilateral), but not painful. Other causes of groin pain such as adductor tendinopathy, symphisitis or sports hernia were not found. Control group was by definition asymptomatic, and anterior and posterior impingement tests were not painful.

Radiological results

Radiological analysis was performed on 39 dancer's hips (20 dancers, one hip excluded due to a technical problem during MRI scan) and on 28 controls' hips (14 controls).

- ***Morphology***

Dancers' femoral neck anteversion, acetabular version and acetabular depth were normal and comparable to controls. Femoral neck-shaft angle was lower in dancers than in controls. This result was statistically significant (Table 4). Alpha neck angles in eight positions were analyzed and compared between both groups. Mean α neck angles in those positions were normal in dancers and controls. Cam morphology was found in only one dancer (maximal values), none in the control group (Table 5). Dancers had lower α neck angles than controls in anterior, superior, postero-superior, postero-inferior, inferior and antero-inferior positions, and this was statistically significant.

- ***Pathology***

MRI of the dancers' hips revealed 3 types of lesions: 1) degenerative labral lesions, 2) acetabular cartilage thinning with subchondral cysts, and 3) herniation pits. Degenerative labral lesions were found for both dancers and controls, in superior position. However, cartilage lesions were twice more frequent and more severe in dancers than in controls: 75% of dancers had cartilage tear in superior position (some in postero-superior position), and 28% of controls had cartilage thinning (i.e., less severe than dancers) in antero-superior position. Herniation pits were more than twice more frequent in dancers than in controls (Table 6).

- ***Femoroacetabular congruency***

Dancers while doing the splits in the MRI tube allowed us to assess static femoroacetabular congruency in this extreme position. This analysis showed a mean femoral head subluxation of 2.05 mm (range 0.63-3.56 mm), according to the method described by Gilles et al.[16] We did not observe any privileged direction of femoroacetabular translations.

Correlation between clinical and radiological results

Correlation of clinical and MRI findings led us to classify dancers in 4 groups (Table 7): 1) pain *with* lesions on MRI, 2) pain *without* lesions on MRI, 3) no pain *but* lesions on MRI, 4) no pain and *no* lesion on MRI. 90% of dancers presented labral and/or cartilaginous lesions on MRI; however, only 61% of them were symptomatic. No criteria in the data was found to explain why some dancers having femoroacetabular lesions were painful, while others with the same lesions were not; indeed, lesions on MRI were the same for symptomatic and asymptomatic dancers.

DISCUSSION

This study resulted in several interesting findings: dancers had normal passive hip ROM and bony morphology; 60% of them complained of groin pain while dancing; most of them had labral and/or cartilaginous lesions and showed a femoral head subluxation during extreme movements; no correlation between clinical and radiological findings could be done.

In this study, dancers' hip ROM was normal and we noted a tendency to increased external rotation and abduction (50% were above the normal range), and to decreased internal rotation (30% were below the normal range). This can be explained by constant external rotation of the lower limb in ballet, also called the "turnout" position, as already described in previous studies.[19] Dancers train from childhood to achieve ideal turnout position. Hamilton et al.[20] showed that dancers who trained for 6 hours a week or more at 11-14 years old had significantly less femoral torsion, and then had greater passive external rotation, but this had no influence on the execution of turnout. In our study, the dancers did not present less femoral antetorsion than controls. Therefore, we believe that the trend of increased external rotation and their capacity to achieve turnout and extreme movements may be due to soft tissue adaptation (ligament flexibility and muscle strength) achieved by training during years.[21] In addition, it is important to note that extreme movements such as "développé à la seconde" or "grand battement à la seconde" (see Figure 1) can be achieved thanks to a combination of abduction and external rotation of the hip. Pure abduction would be limited to normal range of motion (30-50°), but thanks to the combination of abduction, flexion and external rotation, dancers can reach an extreme position during "grand battement à la seconde".

Interestingly, it is precisely during this kind of movement that symptomatic dancers complained of groin pain. This let us think that an abnormal femoroacetabular contact may occur during these movements and induce pain in the joint. A French article published in 1979 described hip pain associated with structural abnormalities of the proximal femoral neck in athletes participating in hockey, football, soccer, rugby, martial arts, and tennis[22]. In the present study, MRI allowed us to assess if dancers had morphological abnormalities, such as FAI, explaining their hip lesions and pain. As opposed to what stated Demarais[22], the dancers in our study had pain and/or lesions in spite of normal hip morphology, except for one dancer with a cam FAI. Dancers' labral and acetabular cartilaginous lesions were the same kind of lesions as those found in patients with FAI.[20] However, the lesions were located in the superior/postero-superior position of the acetabular rim, contrary to usual anterior/antero-superior lesions found in cam or pincer FAI.[23,24] Such lesions may be explained by repetitive extreme movements combining abduction and external rotation, such as "grand battement à la seconde". Indeed, Safran et al.[25] confirmed that the greatest strain laterally were at 90° of flexion with abduction and external or neutral rotation. Therefore, the femoral neck may come in abutment with the acetabular rim during dancing movements, leading to a superior/posterosuperior dance-related femoroacetabular abutment. Moreover, Safran et al.[25] showed that when the hip was externally rotated, the posterior labrum had significantly increased strain. Yet dancers have to permanently keep hip external rotation while dancing (i.e., the "turnout" position), this could hence explain why their lesions were found in superior and postero-superior positions.

Another interesting finding in this study was the mean 2 mm femoral head subluxation in split position. Dynamic analysis of the same dancers with motion capture showed us that this femoral head subluxation is even greater during dynamic extreme movements such as "grand battement à la seconde", and seems to be a consequence of femoroacetabular abutment.[26] Femoral head subluxation may also be due to capsular laxity leading to hip micro-instability.[27] Indeed McCormack et al.

showed that the prevalence of hypermobility and "benign joint hypermobility syndrome" is significantly higher in dancers than controls, having an important negative influence and leading to arthralgia.[28] Then, repetitive subluxations could be a cause of pain, acetabular cartilage lesions as seen in this study, and consequent early OA. But early hip OA may also simply be due to overuse with repetitive motion and recurrent impact, as found in other professional sports.[29]

We did also not find correlation between radiological and clinical findings. Dancers groin pain can neither be explained by the type of lesions nor by the ROM and bone morphology, as there was no difference between the 4 groups. In addition, MRI of controls showed that labral and acetabular lesions could be found in asymptomatic patients. Pain can also be caused by muscular and ligamentous structures around the hip joint. Bedi et al.[30] showed that hip pain, in the absence of OA, may be due to a complex combination of mechanical stresses, both dynamic and static, leading to compensatory dysfunction of the periarticular musculature. Due to the constant "turnout" position, dancers have increased external hip rotation and powerful external rotator muscles, and this dysbalance between internal and external rotators could be a cause of hip pain and could be prevented by a more balanced muscle strengthening and stretching.

In summary, prevention could be done by limiting these extreme movements implying femoroacetabular abutment and subluxation and leading with time to early OA. Dancers should be aware of the fine line between maximizing the range and variety of movement versus exceeding their physical limits, thus risking injuries.

Several study limitations need to be stated: 1) the small number of participants (20 dancers and 14 controls), a female study only[31]; 2) the questionnaire on hip pain that was made by the authors and was not referenced in the literature; 3) the radiological analysis that was based on native hip MRI (reliability of the findings estimated at 65%) and not MR arthrography.

CONCLUSIONS

The results of our study are consistent with our hypothesis that repetitive extreme movements can cause femoral head subluxations and femoroacetabular abutments in female ballet dancers with normal hip morphology, which could result in early OA. Pathological changes seen on the MRI were symptomatic in less than two thirds of the dancers..

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Table 1. Questionnaire on hip pain.

Do you have hip pain?	yes / no
If you do, which side?	left / right
Which intensity?	0-1-2-3-4-5-6-7-8-9-10
Since when?	
For how long are you a professional dancer?	
What are your past health problems?	
How is your general health?	
How long can you walk without pain?	________min.
Do you have pain when you climb up stairs?	yes / no
If you do, where do you feel the pain?	inguinal / lateral / buttock
Which side?	right / left
Do you have pain when you go down stairs?	yes / no
If you do, where do you feel the pain?	inguinal / lateral / buttock
Which side?	right / left
Do you have pain when you stay squatted?	yes / no
If you do, where do you feel the pain?	inguinal / lateral / buttock
Which side?	right / left
Do you feel pain when you cross legs?	yes / no
If you do, where do you feel the pain?	inguinal / lateral / buttock
Which side?	right / left
Do you have night pain?	yes / no
Which other movement/position is painful?	

Table 2. Dancers' answers to the questionnaire on hip pain.

	Hip pain		Side of hip pain		Localization of pain			Occurrence	
Dancers	Yes	No	Right	Left	Inguinal	Lateral	Buttock	Dance	Daily living
1	x		x		x			x	
2	x		x		x			x	
3		x							
4		x							
5		x							
6	x		x		x			x	
7	x		x		x			x	
8	x		x		x			x	
9		x							
10		x							
11		x							
12		x							
13	x		x	x	x			x	
14	x		x	x	x			x	
15	x		x			x		x	
16	x		x	x	x (right)	x (left)		x	
17	x		x		x			x	
18	x			x	x			x	
19	x		x	x	x			x	
20		x							

Table 3. Dancers' passive hip range of motion measured in degree by clinical examination. Dancers tend to have increased abduction and external rotation, and decreased internal rotation when compared to normal range.

Hip ROM	Min	Mean	SD*	Max	Normal range
Flexion	115	133	10	150	120-140
Extension	10	19	4	25	10-20
Abduction	30	61	20	100	30-50
Adduction	10	25	13	45	20-30
Internal rotation	5	33	11	50	30-45
External rotation	30	56	13	80	40-50

*SD: standard deviation.

Table 4. Dancers' and controls' hip morphology measured on MRI.

Hip morphology	Dancers (n=39)*		Controls (n=28)*		p-value[†]
	Mean	SD[‡]	Mean	SD[‡]	
Femoral neck-shaft angle (°)	132.5	4.6	135.4	3.4	0.003
Femoral neck anteversion (°)	12.2	6	13.9	7.7	0.386
Acetabular depth (mm)	7.8	1.6	8.8	2.2	0.065
Acetabular version (°)	6.7	5.3	6	5	0.172

*Data are the number of hips
[‡]SD: standard deviation.
[†]P-value obtained with use of Mann-Whitney U test. P-value < 0.05 means that there is a statistically significant difference between dancers and controls.

Table 5. Alpha neck angles (degree) measured on MRI for dancers and controls. The eight positions are illustrated in Figure 3D.

	Dancers (n=39)*				Controls (n=28)*				p-value[†]
Position	Min	Mean	SD[‡]	Max	Min	Mean	SD[‡]	Max	
Anterior	36.5	45.6	5.5	66.3	39	47.5	4	55.1	0.022
Antero-superior	34.9	47.4	7.4	76	35	46	5	54.6	0.550
Superior	32.1	40.9	5.1	54.6	37.8	46.6	4.5	55.3	0.001
Postero-superior	31.2	37.8	3.7	44.1	33.1	43.1	6.7	59.7	0.001
Posterior	30.3	39.2	4.3	48.4	33.8	40.3	4.8	49.6	0.538
Postero-inferior	28.8	38	3.7	48.3	36.7	48.7	7	64.2	0.001
Inferior	32.5	39.9	3.7	48.2	42	51.2	6.3	62.9	0.001
Antero-inferior	32	40.6	3.3	46	35.9	44.7	5.4	57.3	0.002

[*]Data are the number of hips

[‡]SD: standard deviation.

[†]P-value obtained with use of Mann-Whitney U test. P-value < 0.05 means that there is a statistically significant difference between dancers and controls.

Table 6. Percentage of dancers and controls having labral lesions, acetabular cartilage lesions, and herniation pits. For labral lesions, intensity 1 means degeneration (abnormal signal intensity) and intensity 2 means tear (abnormal linear signal intensity extending to the labral surface). For acetabular cartilage lesions, intensity 1 means hyperintensity, intensity 2 means thinning and intensity 3 means tear.

		Dancers (n=39)*	Controls (n=28)*	p-value†
Labral lesions	Incidence	33/39 (85%)	24/28 (85%)	1
	Mean intensity	1.73	1.76	0.745
Acetabular cartilage lesions	Incidence	29/39 (75%)	8/28 (28%)	0.037
	Mean intensity	2.67	1.83	0.007
Pits	Incidence	23/39 (60%)	6/28 (21%)	0.038

*Data are the numbers of hips

†P-value obtained with use of Mann-Whitney U test. P-value < 0.05 means that there is a statistically significant difference between dancers and controls.

Table 7. Repartition of the 20 dancers according to the presence of pain and/or lesions on MRI.

	Lesions on MRI	No lesions on MRI
Pain	11	1
No pain	7	1