Descriptive epidemiology of mechanical hip pathology in adults under 50 years of age. Prospective series of 292 cases: Clinical and radiological aspects and physiopathological review

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Summary  Two hundred and ninety-two patients, aged between 16 and 50 years and presenting with mechanical hip pathology, were included in a prospective multicenter study. The descriptive study concerned the clinical examination and analysis of three X-ray views (AP pelvic, Lequesne false profile and lateral axial view). The series comprised 62% males, mean age 35 years, with 53% right side and 22% bilateral involvement. Initial trauma was reported in 19% of cases, and direct familial history of hip pathology in 20%. Seventy percent of the patients played sports, 30% were high-level athletes, and 17% played combat sports. The physical impingement sign was present in 18% to 65% of cases depending on the variant studied. On imaging (n = 241), 62% of hips showed osteoarthritis, with 25% at the evolved stage. In the series, as a whole, there was a 35% rate of dysplasia, 63% of impingement and 5% of normal X-ray results. The radiologic impingement aspects were 58% cam-type, 19% pincer-type and 23% mixed. Twenty-two percent of dysplasia cases showed signs of associated impingement. Pain experienced exclusively in flexion/internal rotation/adduction on examination showed little sensitivity (20%) but considerable specificity (86%) for the main diagnosis of impingement. The links between impingement and dysplasia are discussed, and an integrative schema of all risk factors is put forward.

Level of evidence: IV, descriptive epidemiological study.

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Introduction

Until Ganz et al. first described femoroacetabular impingement, mechanical hip pathology was mainly imputed to dysplasia or other causes such as coxa profunda or caput varum, or else often considered idiopathic [1]. Described as a femoral (cam effect), acetabular (pincer effect) or mixed morphologic abnormality, impingement accounts for certain joint lesions found in young athletic patients: labrum lesion, cartilage lesion, bone remodeling of the periphery of the acetabulum or bone cysts of the cervicocephalic junction [2,3]. Due to the causal relation between impingement morphotype and joint lesion, the syndrome is also implicated in the genesis of osteoarthritis of the hip [2,4]. When the hip presents no advanced degenerative signs, certain radiological aspects indicate impingement: defective femoral head sphericity or insufficient femoral offset for the cam effect, and acetabular crossover sign or coxa profunda for the pincer effect [5,6]. When osteoarthritis has set in, these signs can no longer be rigorously interpreted.

This recent advance in knowledge prompted us to perform an epidemiological study of mechanical hip pathology, to assess the relative frequency of dysplasia and impingement in a population of symptomatic young adults, using appropriate simple X-ray. The aim was to assess the prevalence of dysplasia and femoroacetabular impingement. This should reduce the rate of hip pathology considered “idiopathic” and help specify the as yet little known interrelations between impingement and dysplasia. Analysis of interview data should help identify risk factors relating to sport, work, trauma and familial history. Physical examination data should shed light on the relevance of the clinical impingement sign, which is often presented as a diagnostic test for the syndrome despite the lack of any well-established quantitative proof.

Material and methods

A prospective multicenter study was performed of patients aged between 16 and 50 years consulting in surgery for hip pain. The study was run in France, in four centers by five investigators (AN, NB, OM, JEG and TB). Only mechanical hip pathology was included, excluding osteonecrosis of the femoral head, bone pathology (benign or malignant tumor, fresh fracture, fatigue fracture), synovial or inflammatory pathology (villonodular synovitis, chondromatosis, rheumatoid polyarthritis), tendinopathy or other extra-articular pathologies. Hips with history of surgery were also excluded, as were hips presenting pain for less than 4 months.

The following risk factors for osteoarthritis of the hip were collected: direct (father, mother) familial history of osteoarthritis of the hip, heavy work, sports, and hip trauma. With respect to sports, the type, level and starting age were recorded.

Clinical examination systematically looked for the impingement sign. Three variants of the sign were studied: (1) pain predominating in flexion/internal rotation; (2) pain exclusively in flexion/external rotation, and (3) reduced pain-free flexion amplitude under internal rotation.

Standard X-ray assessment comprised three views: AP pelvic, Lequesne et al. false profile and lateral axial [7,8]. The lateral axial view was either a Ducroquet or a Dunn lateral view. Cross-sectional imaging (arthroscan or arthro-MRI) was prescribed at the investigator’s discretion.

X-rays were analyzed a posteriori by an independent radiologist blind to the clinical data (LB). Twenty-seven radiologic items were recorded for each hip (Table 1).

Acetabular dysplasia was diagnosed on the basis of at least one of the following criteria: VCE angle less than 20°, VCA angle less than 20°, VCA angle less than 20°, HTE angle greater than 12°, VCA angle less than 20° [Delau- guy]. Pincer effect was diagnosed on the basis of crossover sign or acetabular protrusion, and cam effect on the basis of femoral head bump, anterosuperior neck flatness or ovoid head (on AP or lateral axial view).

Independently of the radiological diagnosis, the investigators recorded their main diagnosis for each hip after full assessment and any arthroscopic or surgical procedure.

Results

Between March 2008 and March 2009, 292 patients were included in the study. Sixty-two percent were male, 38% female. Mean age was 35 years (S.D., 10 yrs), with a bimodal...
distribution: the first frequency peak was in the 30–35-year-old bracket, and the second in the 45–50-year-old bracket. There was 53% right side, 47% left side and 22% bilateral involvement.

Patients reported trauma as the initial cause of their hip pain in 19% of cases. Direct familial history of hip pathology was present in 20%. Ten percent of the patients were heavy manual workers. Thirty percent played regional or national level competitive sports, and 40% leisure or amateur sports; the mean duration of sports activity was 15 years, with a mean starting age of 13. Seventeen percent of the sports players practiced a foot-combat sport. Thirty percent of the patients had no sports activity.

Pain locations involved the groin in 91% of cases, the thigh in 22%, the knee in 11%, the trochanter in 44% and the greater trochanter in 26%; pain was exclusively inguinal in 36% of cases. Symptoms had been in evolution for a mean 2 years, and for more than 3 years for a third of the patients.

Physical examination found pain predominating in flexion/internal rotation in 65% of cases, and exclusively so in 18%. Pain-free flexion amplitude depended on the degree of internal rotation in 43% of cases.

Radiological assessment was available for 241 of the 292 files initially included. Thirty-two percent of these 241 hips showed a radiological aspect of osteoarthritis of the hip.

Dysplasia was present in 35% of the 241 hips, and coxa valga in 5%. A radiological aspect of impingement (cam and/or pincer) was found in 63% of cases. Radiology was normal in 5%. In the subgroup, showing a radiological aspect of impingement (n = 154), 58% included a pure femoral cam effect, 19% a pure pincer effect and 23% both. Acetabular pincer types (n = 65) comprised 23% protrusions and 77% retroversion (positive crossover sign). In a subgroup (n = 50), excluding cases with femoral osteophytes, to avoid confusion with a cam effect, the prevalence of impingement fell to 58%. In 23% of cases of acetabular dysplasia, there were also impingement signs (Tables 2 and 3, Fig. 1).

The diagnoses made by the investigators, without reference to the independent radiologist, were: 25% osteoarthritis of the hip, 42% femoroacetabular impingement, 6% dysplasia, 14% other and 13% uncertain.

The effectiveness of the physical impingement sign as diagnostic test for femoroacetabular impingement (ver-

Table 2 Prevalence of morphological abnormalities, distinguishing the pathologic associations. (In the right-hand column, femoral osteophytes are excluded to avoid confusion with femoral cam effect, which inevitably reduces the prevalence of the latter).

<table>
<thead>
<tr>
<th>Complete series n = 241 (%)</th>
<th>Nonosteothetic hips n = 191 (%)</th>
</tr>
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<tbody>
<tr>
<td>Pure dysplasia</td>
<td>31</td>
</tr>
<tr>
<td>Dysplasia + cam</td>
<td>4</td>
</tr>
<tr>
<td>Pure cam</td>
<td>33</td>
</tr>
<tr>
<td>Cam + pincer</td>
<td>15</td>
</tr>
<tr>
<td>Pure pincer</td>
<td>12</td>
</tr>
<tr>
<td>Normal radiology</td>
<td>5</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>100</td>
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</tbody>
</table>

Table 3 Prevalence of morphological abnormalities, without distinguishing diagnostic associations (n = 241), (logically, the total exceeds 100%).

<table>
<thead>
<tr>
<th>Complete series n = 241 (%)</th>
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<tbody>
<tr>
<td>Acetabular dysplasia</td>
</tr>
<tr>
<td>Femoral cam</td>
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<tr>
<td>Acetabular pincer</td>
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<tr>
<td>Normal radiology</td>
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Discussion

The radiological part of the study confirmed the frequency of three main morphological abnormalities in a population of young adults presenting with painful hip pathology [9]. Dysplasia, acetabular pincer effect or femoral cam effect were present in 95% of the hips. Along with dysplasia (35% of cases), impingement was preponderant (63%), reducing the proportion of X-rays considered normal to 5% when AP pelvic, false profile and lateral axial view were all available. The prevalence of impingement in the present series was high, probably due to recruitment bias on the part of the investigators.

The study highlighted three types of association of morphological abnormality, found in 23% of files in all [10–13]. Each of these associations raises the issue of the validity of radiological diagnosis and more generally of the physiopathological synthesis which is essential for therapeutic decision-making [14]. The association of dysplasia and femoral cam effect was highlighted by several authors, and was found in in 22% of cases of dysplasia in the present series. Abnormalities observed in such cases on the two sides of the joint are to be analyzed separately and ranked according to their respective importance. The association of femoral cam and acetabular pincer effect was questioned by certain authors, but in 14% of the present series,
Table 4  Sensitivity, specificity, positive and negative predictive value of clinical impingement sign as diagnostic test for femoroacetabular impingement. Three variants were studied.

<table>
<thead>
<tr>
<th></th>
<th>Pain predominantly in flexion/internal rotation (%)</th>
<th>Pain exclusively in flexion/internal rotation (%)</th>
<th>Pain-free flexion amplitude influenced by internal rotation (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity</td>
<td>70</td>
<td>20</td>
<td>51</td>
</tr>
<tr>
<td>Specificity</td>
<td>44</td>
<td>86</td>
<td>67</td>
</tr>
<tr>
<td>PPV</td>
<td>63</td>
<td>67</td>
<td>67</td>
</tr>
<tr>
<td>NPV</td>
<td>53</td>
<td>44</td>
<td>51</td>
</tr>
</tbody>
</table>

Figure 2  Right hip pathology in a 21-year-old judoka. AP pelvic view (A), Dunn lateral view (B), and Lequesne false profile (C). Femoral cam and acetabular dysplasia are visible (VCE < 20°). There is also acetabular retroversion, but the crossover sign as sign of acetabular pincer effect is questionable: it could equally indicate insufficient posterior wall and roof development, and acetabuloplasty would in that case be illogical.

femoral asphericity was found in association with acetabular retroversion [15]. The combination of these two radiologic aspects may represent an elevated risk of developing peripheral acetabular lesions, although the present data are unable to demonstrate this. An association of pincer effect and acetabular dysplasia, on the other hand, appears to us to be incoherent. In the present series, crossover sign was found in 12% of cases of dysplasia, but we would not interpret this acetabular retroversion as a sign of pincer effect. On the contrary, the crossover seems to us to be caused by posterior wall hypoplasia while the anterior wall is nonhypoplastic: all of the cases in the present series in which VCE less than 20° was associated with crossover sign had normal VCAs. The distinction should be borne in mind between acetabular retroversion, which is a question of bone morphology, and an acetabular pincer effect, which is a dynamic lesional syndrome. We would stress the importance of the VCE and the VCA angles, and would not take crossover sign into account when the center-edge angle is less than 20° (Fig. 2A, B, C).

On the basis of the finding that dysplasia, acetabular pincer effect and femoral cam effect account for virtually all cases of mechanical hip pathology, we formulated a physiopathological synthesis integrating these three elements as risk factors. Distinguishing insufficient bone coverage and excessive bone coverage and then considering femoral cam as distinct from both, we drew up a synthetic schema of mechanical dysfunction of the hip (Fig. 3). X-ray, however, is not enough to establish the cause of and lesions involved in the mechanical dysfunction: cross-sectional imaging enables labrum morphology to be visualized, guiding diagnosis towards either a pincer effect or dysplasia.

The location and type of lesions found in the labrum, the cartilage and the bone then confirm diagnosis [16–18].

Because the study was based on radiologic aspect, without cross-sectional imaging, a surprising difference was encountered between the rate of dysplasia found by the radiologist on X-ray (35%) and that diagnosed by the investigators (6%). Femoral cam effects associated with borderline dysplasia may have led to a preference in favor of diagnoses of impingement rather than dysplasia, particularly when the...
The frequency of the familial factor found in the present series (20%) confirms previous reports [23, 24]. Lindbergh found a 2-fold higher relative risk of osteoarthritis of the hip in case of direct familial history [1]. McGregor et al. gave the genetic factor a 60% weighting on the basis of a twins study [25]. These like the present study, however, do not rule out confounding factors linked to such heredity, such as joint morphology.

The authors who described femoroacetabular impingement laid stress on the value of the impingement sign: femoral neck contact with anterosuperior acetabular periphery, which is usually damaged. The present study, however, seemed to show a limited value for this test, which we take to be a reliable sign of hip pathology without drawing any further conclusion in the absence of imaging.

The radiological analysis of the present series highlighted the early and severe nature of joint deterioration in a mainly athletic population under the age of 50. Sixty-two percent of hips showed degenerative radiological signs and 25% were at the stage of evolved osteoarthritis, unmanageable by conservative intervention. These high figures show the importance of early diagnosis so as to act on the evolution of the osteoarthritis, etiological management of joint deterioration being effective only on hips still in the prearthritic stages.

Conclusion

The present study confirmed the preponderance of two types of morphological abnormality in a series of young patients presenting with mechanical hip pathology: dysplasia (35%) was less frequent than impingement (63%), while radiology was interpreted as normal in 5% of cases. It remains, however, essential to distinguish between femoral cam and acetabular pincer type impingement to interpret joint dysfunction rigorously, as certain associations are frequent (dysplasia + cam, cam + pincer), while others are hardly realistic (dysplasia + pincer). In radiological diagnosis of the pincer effect, the crossover sign thus loses its importance in case of insufficient external coverage. A global schema integrating all risk factors is put forward to synthesize pathologic associations and guide treatment. Cross-sectional imaging remains essential to confirm the cause of dysfunction. High-level sport was a major risk factor (30% of cases), and combat sports in particular (17%). The existence of a familial risk factor for hip pathology was confirmed (20%). We challenge the effectiveness of the clinical impingement sign, which we consider rather as a sign of hip pathology, without further diagnostic contribution. Finally, we stress the early nature of hip pathology in athletes and that management too often comes too late, limiting the possibilities of conservative treatment.

Conflict of interest statement

None.

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References


