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Clinical criteria for suspected early hip osteoarthritis at the earliest radiographic stage: an international Technical Expert Panel study

Alberto Migliore

migliore.alberto60@gmail.com

Ospedale San Pietro Fatebenefratelli

Suhel Gabriele Al Khayyat

University of Siena

Raveendhara R. Bannuru

Tufts Medical Center

Xavier Chevalier

Centre Hospitalier Universitaire Henri-Mondor

Sergio Crimaldi

Humanitas Mater Domini

Gabriel Herrero-Beaumont

Instituto de Investigación Sanitaria Fundación Jiménez Díaz

Giovanni Iolascon

University of Campania "Luigi Vanvitelli"

Ruxandra Ionescu

Carol Davila University of Medicine and Pharmacy

Jorge Lains

Centro de Medicina de Reabilitação da Região Centro Rovisco Pais

Liudmila Alekseeva

Association of Rheumatologists of Russia

Emmanuel Maheu

Hôpital Saint-Antoine

Marco Matucci-Cerinic

IRCCS Ospedale San Raffaele

Souzi Makri

EUPATI Graduate and Patient Advocate

Natalia Martusevich

Belarusian State Medical University

Robert J. Petrella

Western University

Umberto Tarantino

Policlinico Tor Vergata

Raghu Raman

Hull and East Yorkshire Hospitals NHS Trust

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Abstract

Background

Early hip osteoarthritis (EHOA) remains challenging to recognise at presentation, particularly when symptoms are recent and radiographic abnormalities are absent or minimal. Standardised clinical criteria for this stage are limited. This study aimed to develop expert-derived criteria for identifying suspected EHOA at the earliest radiographic stage and to propose monitoring suggestions.

Methods

An international, multidisciplinary Technical Expert Panel study was conducted, supported by a structured literature review and expert panel voting. Candidate items were generated from the literature review and face-to-face expert discussion, then organised into domains and subdomains. Items were included in the final framework when they achieved > 66% agreement. The perceived strength of each retained item was rated on a 0–10 numerical scale.

Results

The final framework included two overarching areas: criteria for identifying suspected EHOA and suggestions for careful monitoring. Five domains were retained for identification: exclusion/applicability criteria, symptoms and signs, risk factors, time framework and imaging. Key clinical indicators included load-related mechanical pain, pain during hip rotation, brief start-up or morning stiffness, walking limitation and difficulty with squatting, getting in or out of a car, and putting on socks. Supportive risk factors included elevated body mass index, previous hip symptoms, occupational loading, high-level sports participation, previous hip injury or surgery, family history, femoroacetabular impingement, hip dysplasia, Legg-Calve-Perthes disease, slipped capital femoral epiphysis and leg-length discrepancy. A symptom duration of < 6 months was retained as the preferred timeframe. Baseline radiography was emphasised to exclude established OA, while MRI and ultrasound were considered selective complementary tools.

Conclusions

This Technical Expert Panel proposes a clinical framework for identifying suspected EHOA at the earliest radiographic stage and guiding careful monitoring. Prospective studies are required to validate its diagnostic and prognostic performance before clinical implementation as formal criteria.

Background

Osteoarthritis (OA) of the hip is one of the most prevalent causes of musculoskeletal pain, leading to medical consultation worldwide[1][2]. Owing to its high prevalence, hip OA is a major contributor to disability and healthcare utilisation, and imposes a substantial socioeconomic burden with a marked adverse impact on patients' quality of life[1–3]. In more advanced stages, the disease is commonly characterised by activity-related groin pain and progressive functional limitation, which may substantially impair daily functioning and overall well-being[4].

Although numerous studies have demonstrated the effectiveness of pharmacological and non-pharmacological interventions in the early and intermediate stages of OA, definitive treatment in more advanced disease remains joint replacement surgery, which entails an operative procedure, prolonged rehabilitation, and increased healthcare costs[3]. Intra-articular therapies, together with appropriate conservative management and lifestyle modification, may help relieve symptoms and, in selected patients, delay progression to surgical management[5–7]. However, delayed diagnosis and conflicting recommendations in the literature continue to complicate disease management, which often relies heavily on the expertise and clinical judgement of healthcare professionals[8].

The aim of this work was to identify, through an international multidisciplinary Technical Expert Panel, key clinical indicators for suspected EHOA at the earliest radiographic stage, and to develop practical monitoring suggestions for routine clinical practice.

Methods

Study design and Technical Expert Panel meetings

This was an international Technical Expert Panel study informed by a structured review of the literature and expert panel voting. The process was designed to identify clinically relevant domains and subdomains for suspected EHOA at the earliest radiographic stage, and to develop practical suggestions for careful monitoring. Face-to-face expert meetings were held in Athens, Greece, in October 2023, and Rome, Italy, in October 2024. No protocol for this expert panel exercise was prospectively registered.

Structured literature review

A structured literature review was conducted by a trained librarian to identify existing definitions and operational descriptors of early hip osteoarthritis (EHOA). The search strategy was specifically designed to retrieve studies addressing definitions or descriptions of EHOA. The PICO(T/S) framework was restricted to the Population and Outcome components, because definitions of EHOA may be reported either in the description of the target population, such as eligibility criteria, or in outcomes, such as cohorts of initially unaffected individuals followed until the development of OA.

Eligible study designs included clinical trials, prospective and retrospective observational longitudinal studies, consensus and Delphi exercises, and qualitative studies, including interviews and focus groups,

in order to maximise sensitivity. The search strategy combined terms related to OA and the hip with descriptors of early or initial disease, including “early onset”, “early-onset”, “pre-radiological”, “pre-radiographic”, “pre-clinical”, “recent onset”, and “early osteoarthritis”. These terms were used as search descriptors to capture the breadth of terminology used in the literature and were not intended to define the target condition as exclusively pre-radiographic. Searches were conducted in MEDLINE, Embase and the Cochrane Library, as well as in ACR and EULAR abstract archives. Searches were limited to studies in adult human populations, with no language restrictions.

The librarian developed the search strategies, and all records were imported into a bibliographic database (EndNote), where duplicates were removed. Full-text articles were retrieved for potentially relevant studies. Two independent reviewers screened titles and abstracts and subsequently assessed full-text articles for inclusion. Data were extracted using predefined forms, including bibliographic information, study design, setting, inclusion and exclusion criteria, definitions of OA and key findings. Risk of bias was assessed by an experienced clinical epidemiologist using study design-specific SIGN checklists. The literature review was used to inform item generation for the subsequent Technical Expert Panel discussion and expert panel voting process.

Expert panel composition and item generation

The international multidisciplinary Technical Expert Panel consisted of 18 members, including rheumatologists, orthopaedic surgeons, physiatrists, sports medicine physicians and patient-advocacy expertise. Panel members were selected on the basis of clinical and academic expertise in OA, musculoskeletal medicine, imaging, rehabilitation or patient representation. Following presentation of the structured literature review findings during the face-to-face expert meeting, a structured brainstorming process was undertaken to identify all potential items relevant to the concept, clinical identification and monitoring of EHOA.

Candidate items were initially grouped into broad domains to facilitate discussion, including symptoms, risk factors, physical examination, imaging and biomarkers. Panel members were then invited to share their conceptual perspectives on EHOA, including the clinical features, risk factors, imaging findings and differential diagnostic considerations that could be relevant to its early identification in routine practice. Through iterative discussion of domains and individual items, two overarching areas were defined: (A) candidate criteria for identifying suspected EHOA and (B) candidate suggestions for careful monitoring. These overarching areas were subsequently organised into domains, microdomains and subdomains, which were refined and prepared for expert panel voting.

Expert panel voting process

An expert panel voting process was undertaken to determine whether each subdomain should be included in the final framework. Subdomains were retained if more than 66% of panel members voted in

favour of inclusion within either the “criteria for identifying suspected EHOA” or the “suggestions for careful monitoring” domains. Final agreement percentages and perceived item-strength scores were recorded for each retained item. Following item selection, the perceived clinical relevance or strength of each retained item was assessed using a numerical rating scale ranging from 0, indicating the lowest perceived strength, to 10, indicating the highest perceived strength.

Development of the clinical framework

Retained domains and subdomains were organised into a pragmatic clinical framework for identifying suspected EHOA at the earliest radiographic stage. The framework distinguishes between criteria supporting clinical identification and suggestions for careful monitoring. Risk factors were considered supportive features that increase clinical suspicion but were not intended to be mandatory for identifying suspected EHOA. The final algorithm was derived from the retained domains and subdomains and was intended to represent the sequence of clinical assessment rather than a weighted scoring system.

Results

Starting from candidate items generated by the structured literature review, the Technical Expert Panel defined two overarching areas relevant to suspected EHOA: (A) criteria for identifying suspected EHOA and (B) suggestions for careful monitoring. The criteria for identifying suspected EHOA were organised into five domains: exclusion/applicability criteria, symptoms and signs, risk factors, time framework and imaging. Following expert panel discussion and voting, items meeting the predefined agreement threshold were retained in the final framework, and the perceived clinical relevance or strength of each retained item was scored on a 0–10 numerical scale. Final retained domains and subdomains are presented in Tables 1–6. Items that did not meet the predefined agreement threshold are reported in Additional file 1: Supplementary Table 1.

Criteria for identifying suspected EHOA

Exclusion/applicability criteria

The panel retained several exclusion/applicability criteria to be considered before applying the proposed framework for suspected EHOA. The highest agreement was observed for active inflammatory joint disease and referred pain from other anatomical regions, both of which reached 100% agreement. Recent hip trauma or injury explaining the current symptoms was also strongly supported. The panel further retained established radiographic hip OA beyond Kellgren–Lawrence grade 0–1 as an exclusion/applicability criterion, supporting the use of baseline radiographic assessment to exclude established disease. Other retained criteria included generalised pain not localised to the hip, trochanteric enthesitis or bursitis, femoral head osteonecrosis, and other mechanical or non-mechanical causes of hip pain, including snapping hip, bone marrow lesions, tumours, infection or trauma.

Table 1. Exclusion/applicability criteria for suspected EHOA

Criterion	Agreement, %	Perceived item-strength score, 0–10
Generalised pain not localised to the hip	88.9%	8.6
Active inflammatory joint disease	100%	9.2
Established radiographic hip OA beyond Kellgren–Lawrence grade 0–1*	82.4%	9.0
Recent hip trauma or injury explaining the current symptoms	98.4%	8.2
Trochanteric enthesitis or bursitis	88.9%	7.5
Femoral head osteonecrosis or other mechanical/non-mechanical causes of hip pain, including snapping hip, bone marrow lesions, tumours, infection or trauma	94.4%	8.9
Referred pain from other anatomical regions	100%	8.8

*The initial exclusion criterion “radiological hip OA >0” did not meet the predefined agreement threshold. It was subsequently reformulated as radiographic hip OA beyond Kellgren–Lawrence grade 0–1, which met the predefined agreement threshold and was retained.

Abbreviations: EHOA, early hip osteoarthritis; KL, Kellgren–Lawrence; OA, osteoarthritis.

Symptoms and signs

Symptoms and signs retained after expert panel voting reflected a predominantly mechanical pattern of hip-region symptoms and early functional limitation. High agreement features included pain exacerbated by mechanical loading, pain during flexion and internal rotation, short start-up or morning stiffness, walking limitation, sport limitation and difficulty with activities such as squatting, getting in and out of a car, rising from bed and putting on socks.

Table 2. Symptoms and signs retained as clinical indicators of EHOA

Symptom or sign	Agreement, %	Perceived item-strength score, 0–10
Pain exacerbated by mechanical loading	100%	8.8
Pain when squatting	83.3%	7.8
Pain during hip rotation	100%	8.7
Very short start-up stiffness	94.4%	8.1
Short morning stiffness	77.8%	7.5
Difficulty running or walking rapidly after a period of inactivity	88.9%	8.5
Walking limitation	94%	9.0
Discomfort or limitation when getting in or out of a car	94.4%	8.2
Difficulty putting on socks and/or discomfort when rising from bed	94.4%	7.9
Discomfort when rising from bed	77.8%	7.6
Limitation of internal rotation during cross-legged sitting	94.4%	8.3

Abbreviations: EHOA, early hip osteoarthritis.

Risk factors

Risk factors were retained as supportive features that may increase clinical suspicion of EHOA but were not considered mandatory criteria. Retained risk factors included elevated BMI, previous hip symptoms, occupational mechanical loading, high-level or competitive sports participation, previous hip injury or surgery, osteochondral defects, family history of hip OA, leg-length discrepancy and structural hip conditions such as femoroacetabular impingement, hip dysplasia, Legg-Calve-Perthes disease and slipped capital femoral epiphysis.

Table 3. Risk factors retained as indicators of increased likelihood of EHOA

Risk factor	Agreement, %	Perceived item-strength score, 0–10
Overweight or elevated BMI	77.8%	7.8
Previous hip symptoms or disorders	83.3%	8.1
Occupational mechanical loading	94.4%	8.4
High-level or competitive sports participation	94.4%	8.7
Previous hip injury or surgery	88.9%	8.7
Osteochondral defects	88.9%	8.2
Family history of hip osteoarthritis	94.4%	8.1
Femoroacetabular impingement, hip dysplasia, Legg–Calvé–Perthes disease or Slipped Capital Femoral Epiphysis	94.4%	8.7
Leg-length discrepancy >20 mm	88.3%	7.8

Abbreviations: BMI, body mass index; EHOA, early hip osteoarthritis; FAI, femoroacetabular impingement; OA, osteoarthritis.

Time framework

Symptom duration <6 months was retained as the preferred time framework for identifying suspected EHOA at the earliest radiographic stage. Longer symptom duration was considered less compatible with the intended early-identification purpose of the framework and may warrant reassessment for established OA or alternative diagnoses.

Table 4. Time framework for suspected EHOA

Criterion	Agreement, %	Perceived item-strength score, 0–10
Symptom duration <6 months	88.9%	8.1

Abbreviations: EHOA, early hip osteoarthritis.

Imaging

Baseline imaging was retained as a key domain for identifying suspected EHOA at the earliest radiographic stage and for excluding established hip OA or alternative causes of hip-region pain. Conventional radiography achieved full agreement as a baseline investigation and was considered necessary to exclude established radiographic hip OA, defined in this framework as Kellgren–Lawrence grade >1. In this context, suspected EHOA was considered compatible with absent or minimal radiographic abnormalities, corresponding to Kellgren–Lawrence grade 0–1. MRI was highly supported

as a complementary modality to assist early clinical identification and to exclude alternative or concomitant conditions, including femoral head osteonecrosis, bone marrow lesions, tumours, infection, trauma or other mechanical and non-mechanical causes of hip pain. Ultrasound (US) was also retained as a useful complementary tool, particularly for identifying synovitis, joint effusion and periarticular causes of hip pain such as iliopsoas bursitis, as well as other soft-tissue abnormalities that may mimic or coexist with early hip OA.

Table 5. Imaging recommendations for evaluation of suspected EHOA

Imaging recommendation	Agreement, %	Perceived item-strength score, 0–10
MRI highly recommended to support detection of early OA-related structural changes; selectively used at baseline to exclude alternative diagnoses	88.9%	8.3
US may help detect synovitis, effusion and alternative causes of pain, such as iliopsoas bursitis	94.4%	7.8
Baseline radiography recommended to exclude Kellgren–Lawrence grade >1	100%	9.0

Abbreviations: EHOA, early hip osteoarthritis; KL, Kellgren–Lawrence; MRI, magnetic resonance imaging; OA, osteoarthritis; US, ultrasound.

Suggestions for careful monitoring

The panel retained three suggestions for careful monitoring of individuals with suspected EHOA. Weight control and lifestyle modification achieved full agreement, reflecting their perceived relevance as baseline measures in patients with early hip symptoms. Scheduled clinical follow-up every 6 months, with earlier reassessment in the event of symptom change or worsening, was also strongly supported. Repeat radiography and/or MRI was retained as a conditional monitoring strategy, to be considered only when symptoms persist or worsen rather than as routine serial imaging.

Table 6. Suggestions for careful monitoring retained after expert panel voting

Monitoring suggestion	Agreement, %	Perceived item-strength score, 0–10
Weight control and lifestyle modification	100%	9.0
Follow-up every 6 months, or earlier if symptoms change or worsen	94.4%	8.1
Repeat radiography and/or MRI only if symptoms persist or worsen	88.9%	9.0

Abbreviations: EHOA, early hip osteoarthritis; MRI, magnetic resonance imaging.

Discussion

This Technical Expert Panel addressed the clinical grey zone of patients with recent hip-region symptoms in whom EHOA is suspected, but established radiographic disease is not yet present. At this stage, clinical assessment cannot rely on imaging alone and requires the combined interpretation of symptom pattern, functional limitation, individual risk profile and possible alternative diagnoses. The proposed framework brings these elements together in a structured way, linking literature-derived candidate items with expert judgement to support assessment of suspected EHOA at the earliest radiographic stage. This focus is clinically relevant because the opportunity for conservative measures, weight control, lifestyle modification and careful monitoring is greatest before structural damage becomes advanced and hip arthroplasty becomes the only definitive therapeutic option[5].

Applicability criteria/exclusion criteria

The proposed applicability and exclusion criteria are intended to identify patients in whom the framework for suspected EHOA can be appropriately applied and to distinguish suspected EHOA from alternative causes of hip-region pain. Within this framework, the principal clinical feature supporting suspicion of EHOA is mechanical pain localised to the hip, typically exacerbated by weight-bearing activities such as walking. Mechanical symptoms should be differentiated from pain patterns suggestive of systemic inflammatory disease, which may include prolonged morning stiffness, pain at rest and improvement with movement[9][10]. Nevertheless, pain characteristics alone are insufficient to establish suspected EHOA, and their interpretation should be based on the overall clinical presentation.

Systemic inflammatory arthritides should be considered before applying the proposed framework to a patient with suspected EHOA. Rheumatoid arthritis may involve the hip, including during relatively early disease, while hip involvement is a clinically important manifestation of axial spondyloarthritis and ankylosing spondylitis[10][11]. A careful history and examination should therefore assess for inflammatory symptoms, involvement of other joints, enthesitis, inflammatory back pain and relevant extra-articular manifestations. Laboratory testing or specialist rheumatological assessment may be appropriate when an inflammatory disorder is suspected.

Generalised or disproportionate pain should also prompt consideration of a widespread pain disorder. Fibromyalgia (FM) is characterised by diffuse pain accompanied by variable fatigue, sleep disturbance, cognitive symptoms and enhanced pain sensitivity; this presentation differs from the predominantly localised, mechanically provoked pain pattern expected in EHOA[12]. FM and structural hip disease may, however, coexist, and its presence should not automatically preclude further assessment when focal hip symptoms or clinical signs are also present[13].

Radiographic findings represent an important applicability criterion. In the present Technical Expert Panel framework, Kellgren–Lawrence grade >1 was considered inconsistent with suspected EHOA at the earliest radiographic stage, because it indicates that established radiographic hip OA is already present. This threshold was adopted after reformulation and repeat voting by the expert panel. The proposed

framework should not, however, be interpreted as defining EHOA solely by radiographic findings. Its principal purpose is to identify a clinically symptomatic stage in which conventional radiographs are either normal or show only minimal abnormalities compatible with Kellgren–Lawrence grade 0–1.

Alternative intra-articular and osseous conditions should also be excluded when indicated. Femoral head osteonecrosis, stress injury, transient osteoporosis of the hip and other bone marrow abnormalities may cause hip pain despite initially normal or inconclusive radiographs[14]. Bone marrow lesions are non-specific and may occur in degenerative, traumatic, inflammatory or transient bone marrow oedema conditions; their presence should therefore be interpreted in the appropriate clinical and imaging context[15]. MRI is particularly useful when these diagnoses are suspected, including in patients with persistent or severe symptoms that are unexplained by conventional radiography. MRI should consequently be considered selectively rather than regarded as mandatory for every patient at first presentation.

The possibility of referred or extra-articular pain must also be assessed. Lumbar spine disorders, sacroiliac pathology and other pelvic or inguinal conditions can produce pain perceived in the hip or groin and may mimic intra-articular disease[4]. The choice of additional investigations should be guided by the clinical presentation; MRI may be appropriate for selected spinal, osseous or intra-articular conditions, whereas targeted ultrasonography or other investigations may be more informative for superficial soft-tissue or inguinal disorders.

Snapping hip syndrome should be considered when patients report an audible or palpable snapping sensation during movement. Internal snapping commonly involves movement of the iliopsoas tendon over an underlying bony prominence, whereas external snapping is generally associated with movement of the iliotibial band or gluteus maximus over the greater trochanter[16]. These characteristic mechanical phenomena provide an alternative explanation for symptoms and differ from the pain, brief stiffness and functional limitation forming the proposed EHOA presentation. Snapping hip may nevertheless coexist with intra-articular pathology; its identification should therefore prompt appropriate differential assessment rather than automatically excluding OA.

Recent trauma should similarly prompt investigation for acute injury—including fracture, muscle or tendon injury, labral damage or bone contusion—before the proposed framework is applied[4]. The distinction between recent and previous trauma is important: recent trauma may provide a more immediate explanation for symptoms, whereas previous significant joint injury can increase the subsequent risk of post-traumatic OA[17]. A remote history of hip injury or surgery should therefore be considered a risk factor rather than an exclusion criterion.

Finally, greater trochanteric pain syndrome and related peri-trochanteric disorders should be considered in patients with predominantly lateral hip pain. This syndrome encompasses a spectrum of conditions, including gluteal tendinopathy or tears, trochanteric bursitis and external snapping hip, and may mimic or coexist with intra-articular hip pathology[18]. Similarly, enthesitis may indicate an underlying inflammatory spondyloarthritis when accompanied by compatible clinical features[18]. Careful

localisation of pain, palpation, functional testing and, where appropriate, US or MRI can help distinguish these disorders from suspected EHOA.

Taken together, these applicability and exclusion criteria are not intended to establish an EHOA diagnosis independently. Rather, they provide a structured approach for determining whether the proposed framework is appropriate in patients with suspected EHOA and for reducing the risk that alternative inflammatory, traumatic, osseous, extra-articular or referred causes of hip-region pain are misclassified as EHOA.

Signs and symptoms

Signs and symptoms represent a key subdomain within the proposed criteria for identifying suspected EHOA and are central to clinical suspicion. In this Technical Expert Panel framework, the most relevant symptomatic feature is mechanical hip-region pain, typically exacerbated by load-bearing activities and movements such as walking, squatting, hip flexion and internal rotation[4]. This activity-related pain pattern, particularly when localised to the groin or hip region, may help distinguish suspected intra-articular hip disease from referred, extra-articular or systemic inflammatory causes of pain, although it should always be interpreted within the broader clinical context.

Although inflammatory features such as synovitis may occur in OA, the clinical presentation of hip OA is generally distinguished from systemic inflammatory arthritides by pain related to activity or loading, together with absent or brief morning stiffness. Accordingly, the expert panel considered that morning stiffness or start-up stiffness in suspected EHOA should be transient, typically lasting only a few minutes. This short duration of stiffness is clinically relevant because prolonged stiffness, pain at rest, rapidly progressive symptoms or a hot swollen joint should prompt consideration of alternative inflammatory, infectious or other non-OA diagnoses[4][19].

Mechanical pain associated with absent or brief stiffness may also translate into early functional limitation. Patients with suspected EHOA may report reduced walking capacity, difficulty resuming rapid walking or running after inactivity, limitations in sports participation, pain or discomfort during squatting, and difficulty with daily activities requiring hip flexion or rotation, such as getting in and out of a car, rising from bed or putting on socks[9]. These functional manifestations reinforce the clinical relevance of timely recognition of suspected EHOA and support the use of structured criteria to identify patients who may benefit from further evaluation, careful monitoring and appropriate early management.

Risk factors

The Technical Expert Panel identified several risk factors that may increase clinical suspicion of suspected EHOA and support consideration of specialist evaluation when compatible hip symptoms are present. Among lifestyle- and activity-related factors, high-level or competitive sports participation was retained as relevant. Evidence from systematic reviews suggests that participation in elite or high-impact

sports may be associated with an increased risk of hip OA, although this relationship varies according to sport type, previous injury, sex and underlying hip morphology[20][21].

Anatomical and developmental hip disorders were also considered important risk factors. Femoroacetabular impingement has been strongly linked to early structural damage and subsequent hip OA, particularly through abnormal contact between the femoral head-neck junction and the acetabular rim[22-26]. Similarly, childhood or adolescent hip disorders, including slipped capital femoral epiphysis and Legg–Calvé–Perthes disease, may result in residual deformity and altered hip biomechanics in adulthood, thereby increasing susceptibility to degenerative change[27].

Leg-length discrepancy greater than 20 mm was retained as an additional mechanical risk factor. Evidence from the Multicentre Osteoarthritis Study and the Osteoarthritis Initiative supports an association between leg-length inequality and hip OA[28]. Together with femoroacetabular impingement, dysplasia, osteochondral defects, previous hip injury or surgery and occupational mechanical loading, leg-length discrepancy may contribute to unfavourable load distribution across the hip joint and promote degenerative change through altered biomechanics[22][23][26][28][29].

Other retained risk factors included strenuous occupational exposure, such as manual labour or farming[30], previous hip surgery, osteochondral defects and elevated BMI. Although the relationship between BMI and hip OA remains more debated than for knee OA, elevated BMI was retained by the panel as a risk factor. This decision is supported by evidence suggesting an association between obesity-related traits and increased risk of OA, including hip OA and total hip replacement[31]. Family history was also retained, consistent with epidemiological evidence indicating that genetic and familial factors contribute to the risk of clinically diagnosed hip OA[32][33].

Overall, the presence of one or more of these risk factors should be interpreted as increasing the likelihood of suspected EHOA in patients with compatible hip-region symptoms, rather than as establishing the condition independently. In the proposed framework and algorithm (Fig. 1), risk-factor assessment is intended to complement, rather than replace, clinical evaluation, physical examination and appropriate imaging. Systematic assessment of these factors may help clinicians recognise patients who warrant closer monitoring, lifestyle intervention or specialist assessment before established radiographic hip OA is present.

Time framework

The Technical Expert Panel retained a symptom duration of less than 6 months for the purpose of identifying suspected EHOA. This threshold was selected to define a recent-onset symptomatic phase in which clinical manifestations may occur before established radiographic hip OA is present, or in association with only minimal radiographic abnormalities. Although the 6-month interval has not been validated as a disease-specific biological cut-off for hip OA, it is consistent with the broader concept that OA develops through early whole-joint changes before advanced structural damage is visible on conventional radiographs. Contemporary definitions describe OA as a whole-joint disorder initiated by

cellular stress and extracellular matrix degradation after micro- or macro-injury, with maladaptive repair responses involving cartilage, subchondral bone, synovium and other joint tissues[34]. Similarly, the concept of pre-OA recognises that biological and cellular processes may be active before structural abnormalities become evident on conventional imaging[35].

Preclinical evidence also supports the existence of an early window in which OA-related tissue changes may develop over weeks to months after joint insult. In surgically induced murine models, cartilage lesions may appear within 2–4 weeks and progress over subsequent weeks, with osteophyte formation and more advanced degenerative changes occurring by 4–8 weeks depending on the severity of joint instability[36][37]. In rat models, early cartilage and subchondral bone changes have similarly been detected within 2–6 weeks after experimental induction[38]. These findings cannot be directly extrapolated to human hip OA, which is typically more heterogeneous and often progresses more slowly, but they support the biological plausibility that recent-onset symptoms may reflect active tissue-level change before established radiographic OA is present.

In humans, particularly in hip OA, the relationship between symptoms, radiographic change and tissue pathology is complex. Radiographic progression may be slow and discordant with symptoms, while MRI can demonstrate cartilage, labral, bone marrow and synovial abnormalities that are not visible on conventional radiographs[39]. Therefore, the <6-month timeframe should be interpreted as a clinically pragmatic criterion designed to favour timely recognition and assessment, rather than as evidence that EHOA necessarily progresses to established OA after this interval. Patients with symptoms lasting longer than 6 months should not automatically be excluded from evaluation; however, longer symptom duration should increase attention to established radiographic OA, alternative diagnoses and the need for careful clinical-imaging correlation.

Timely identification may also be therapeutically relevant because conservative and intra-articular treatments may be more appropriate, and potentially more effective symptomatically, before advanced structural damage has occurred. In hip OA, evidence suggests that radiographic severity and joint-space narrowing may influence response to viscosupplementation, with more severe joint-space narrowing associated with poorer response[40]. This concept is consistent with knee OA literature, in which patients with milder radiographic disease appear more likely to respond to hyaluronic acid injections than those with more advanced disease[41]. The European Viscosupplementation Consensus Group (EUROVISCO) recommendations similarly recognise radiological severity and joint-space narrowing as factors that may influence the clinical response to viscosupplementation in both knee and hip OA[42].

Accordingly, the proposed time framework supports prompt clinical evaluation, structured monitoring and timely initiation of appropriate conservative strategies, including education, activity modification, physical therapy, lifestyle optimisation and, where appropriate, pharmacological or intra-articular treatments. However, the potential benefit of early intervention should be stated cautiously: although hyaluronic acid injections have shown symptomatic benefit in selected patients with hip OA[5-7][43][44], evidence that they modify the structural course of EHOA remains insufficient. Other biological therapies,

including platelet-rich plasma and mesenchymal stem cell-based approaches, remain promising but require further high-quality evidence before they can be recommended as routine interventions for EHOA[45][46].

Role of imaging

Imaging plays a central role in the evaluation of suspected EHOA, particularly for defining the earliest radiographic stage, excluding established radiographic hip OA and assessing alternative causes of hip-region pain. Conventional radiography should generally be considered the first-line imaging modality at baseline. Standing anteroposterior pelvic radiographs are useful to assess radiographic OA severity and to exclude patients with established structural disease, defined in the present framework as Kellgren–Lawrence grade >1. In selected cases, additional radiographic views, including the Lequesne false profile view, may provide complementary information by improving assessment of joint-space narrowing that may not be fully captured on standard anteroposterior views[39][47].

MRI has an important role in the assessment of suspected EHOA, particularly when symptoms are disproportionate, radiographs are normal or equivocal, or alternative diagnoses need to be excluded. Compared with radiography, MRI is more sensitive for detecting cartilage, labral, bone marrow and soft-tissue abnormalities, as well as joint effusion and synovitis[39]. It may also help identify conditions that can mimic or coexist with suspected EHOA, including femoral head osteonecrosis, bone marrow oedema syndromes, subchondral insufficiency fracture, transient osteoporosis of the hip and other intra-articular or periarticular causes of pain[15][48][49]. However, MRI findings must be interpreted in the clinical context, because structural abnormalities may occur in asymptomatic individuals and imaging findings do not always correlate closely with pain or functional impairment[39]. For these reasons, the Technical Expert Panel considered MRI highly valuable for identifying early OA-related structural changes and for refining the differential diagnosis, but best used selectively according to clinical presentation and resource availability.

Musculoskeletal US was also considered a useful complementary imaging tool. US may help identify synovitis, effusion and periarticular soft-tissue conditions, particularly when performed by experienced operators[50][51]. It may also support the evaluation of iliopsoas bursitis and other extra-articular sources of hip-region pain, thereby refining the differential diagnosis in patients with symptoms suggestive of EHOA[51]. Nevertheless, US should not be used in isolation to identify suspected EHOA, because it provides limited assessment of deep intra-articular cartilage, subchondral bone and bone marrow changes.

Overall, the Technical Expert Panel supported a stepwise and clinically driven imaging strategy. Baseline radiography is used to document absent or minimal radiographic abnormalities compatible with Kellgren–Lawrence grade 0–1 and to exclude established radiographic hip OA, while MRI should be considered selectively to identify early structural changes or exclude alternative diagnoses. US may provide complementary information on synovitis, effusion and periarticular soft-tissue pathology. During

follow-up, repeat imaging should generally be guided by persistence, worsening or change in symptoms rather than performed routinely.

Suggestions for careful monitoring

Following expert discussion and expert panel voting, the Technical Expert Panel identified three practical components for careful monitoring of patients with suspected EHOA: weight control and lifestyle modification, scheduled clinical reassessment, and symptom-driven repeat imaging.

Weight control was retained as a modifiable target during follow-up. Although the association between BMI and hip OA is less consistent than that observed for knee OA, population-based and genetic evidence supports a relationship between overweight or obesity and increased risk of clinically diagnosed hip OA[52][53]. Accordingly, monitoring should include reinforcement of lifestyle measures, patient education, therapeutic exercise and weight management where appropriate, in line with contemporary non-surgical OA management recommendations[19][54].

Clinical reassessment every 6 months, or earlier in the event of symptom change or worsening, was also retained as a practical monitoring interval. This schedule was considered useful for reviewing pain, stiffness, functional limitation, adherence to lifestyle recommendations and the possible need to adjust conservative, pharmacological or intra-articular treatment. In patients receiving intra-articular therapies, follow-up also provides an opportunity to assess clinical response and determine whether further intervention is appropriate.

Finally, after baseline imaging has excluded established radiographic hip OA and relevant alternative diagnoses, repeat radiography or MRI should not be performed routinely. Further imaging should instead be guided by persistence or worsening of symptoms, change in clinical presentation or concern for an alternative diagnosis. This approach supports monitoring based primarily on symptoms and function, reserving imaging for situations in which it is likely to influence clinical management[19].

Strengths and limitations

The main strength of this study is the development of a clinically oriented framework for identifying suspected EHOA at the earliest radiographic stage through a literature-informed Technical Expert Panel process involving an international multidisciplinary group. The inclusion of rheumatologists, orthopaedic surgeons, physiatrists, sports medicine physicians and patient-advocacy expertise allowed the proposed criteria to reflect different perspectives relevant to everyday clinical practice. The use of a predefined agreement threshold and numerical perceived item-strength scores further supported transparency in the selection of retained items. However, several limitations should be acknowledged. First, because the study was conducted as a Technical Expert Panel rather than a formal Delphi exercise, the findings should be interpreted as expert-derived clinical criteria rather than formal consensus recommendations. Second, the proposed framework has not yet been validated as a diagnostic or classification tool, and the relative contribution and diagnostic accuracy of individual domains and subdomains could not be

quantified from patient-level data. Third, access to imaging modalities such as MRI and musculoskeletal US may vary across healthcare systems, potentially affecting implementation. Finally, prospective validation in independent cohorts is required to assess feasibility, inter-rater reliability, diagnostic performance, prognostic value and the ability of the framework to identify patients who may benefit from timely management and careful monitoring.

Conclusions

Timely identification of suspected EHOA may represent an opportunity to recognise symptomatic patients before established radiographic hip OA is present and before surgical treatment becomes the dominant therapeutic option. This study provides a literature-informed, expert-derived clinical framework for the assessment and monitoring of suspected EHOA, developed through a structured literature review, expert discussion and expert panel voting by an international multidisciplinary Technical Expert Panel.

The proposed framework integrates exclusion/applicability criteria, symptoms and signs, risk factors, symptom duration and imaging considerations. Mechanical hip-region pain, brief stiffness and early functional limitation emerged as key clinical indicators, while previous hip injury, high-level sports participation, femoroacetabular impingement, hip dysplasia and elevated BMI were recognised as relevant risk factors. Baseline radiography remains essential to document the earliest radiographic stage and to exclude established radiographic hip OA, whereas MRI and US may provide selective complementary information by identifying subtle structural abnormalities or alternative causes of hip-region pain.

The panel also retained suggestions for careful monitoring, including lifestyle optimisation, weight management and structured clinical follow-up. Clinical reassessment every 6 months, or earlier in the event of symptom change or worsening, may help monitor symptoms and function, guide treatment adjustment and determine the need for repeat imaging. The accompanying algorithm is intended to support clinicians in everyday practice by providing a structured approach to the assessment and monitoring of suspected EHOA.

Application of this framework may improve recognition of hip OA at an earlier symptomatic and radiographic stage, enabling timely monitoring and management and potentially reducing disability or delaying progression to joint replacement in selected patients. Future studies should prospectively validate this framework, assess its diagnostic and prognostic performance, and determine whether its implementation improves clinical outcomes in patients with EHOA.

Abbreviations

ACR: American College of Rheumatology
BMI: body mass index
EHOA: early hip osteoarthritis
EULAR: European Alliance of Associations for Rheumatology

EUROVISCO: European Viscosupplementation Consensus Group
FAI: femoroacetabular impingement
FM: fibromyalgia
KL: Kellgren–Lawrence
MRI: magnetic resonance imaging
OA: osteoarthritis
PICO(T/S): Population, Intervention, Comparator, Outcome, Timing/Setting
SIGN: Scottish Intercollegiate Guidelines Network
US: ultrasound

Declarations

Ethics approval and consent to participate

Not applicable. This study did not involve patients, human participants, identifiable personal data, human tissue or animal subjects.

Consent for publication

Not applicable.

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

AM conceived the study and coordinated the expert panel. All authors contributed to item generation, discussion and expert panel voting. SGAK drafted the manuscript. All authors critically revised the manuscript and approved the final version.

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Authors' information

Not applicable.

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Figures

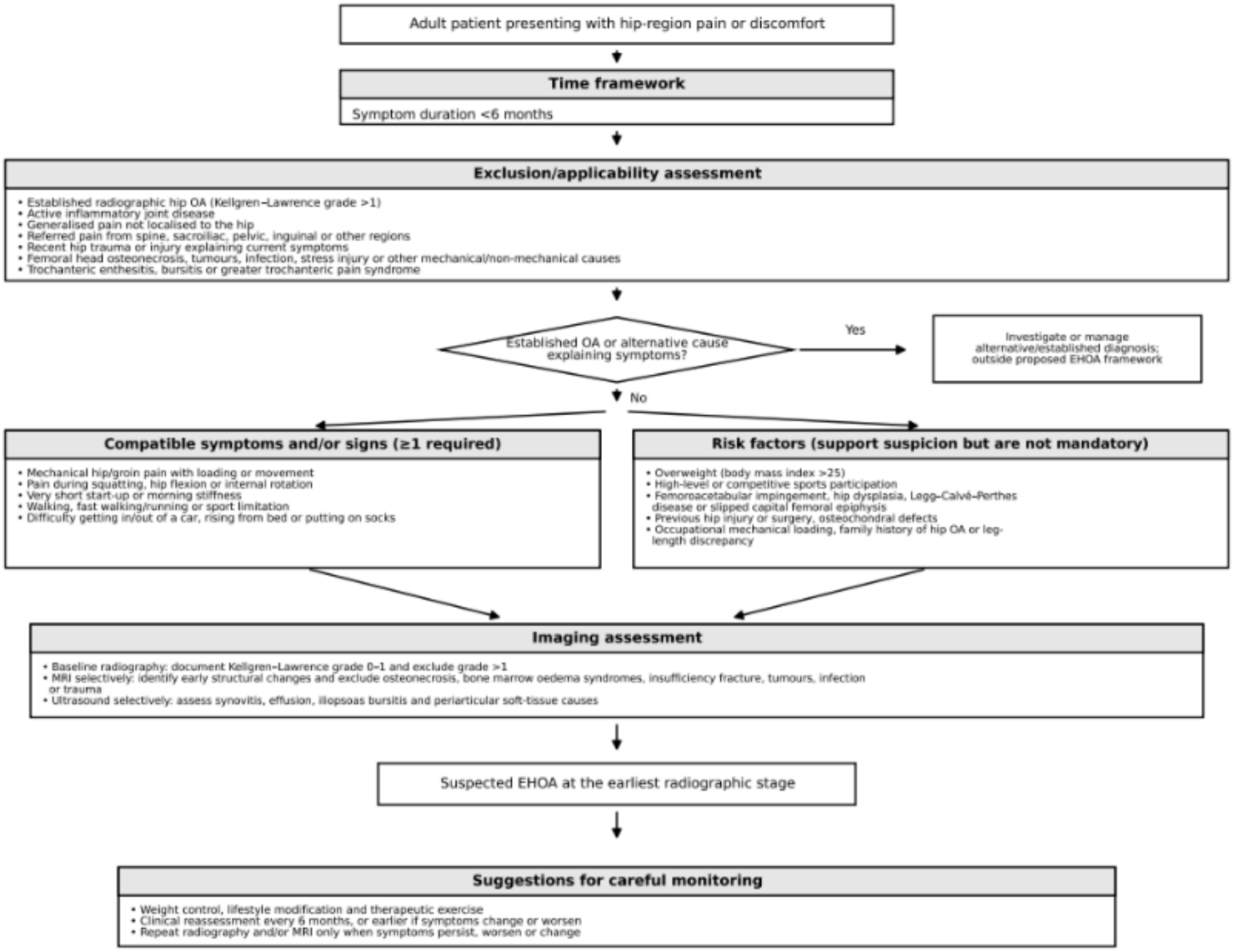


Figure 1

Clinical algorithm for suspected early hip osteoarthritis.

Proposed clinical algorithm for identifying and monitoring suspected early hip osteoarthritis at the earliest radiographic stage.

Abbreviations: EHOA, early hip osteoarthritis; MRI, magnetic resonance imaging; OA, osteoarthritis

Supplementary Files

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