# Complete Summary

## GUIDELINE TITLE

Limping child: ages 0-5 years.

## BIBLIOGRAPHIC SOURCE(S)

Fordham L, Gunderman R, Blatt ER, Bulas D, Coley BD, Podberesky DJ, Prince JS, Tosi L, Expert Panel on Pediatric Imaging. Limping child--ages 0-5 years. [online publication]. Reston (VA): American College of Radiology (ACR); 2007. 5 p. [59 references]

## GUIDELINE STATUS

This is the current release of the guideline.

The appropriateness criteria are reviewed annually and updated by the panels as needed, depending on introduction of new and highly significant scientific evidence.

## COMPLETE SUMMARY CONTENT

SCOPE
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## SCOPE

### DISEASE/CONDITION(S)

Limping child

### GUIDELINE CATEGORY

Diagnosis
Evaluation

### CLINICAL SPECIALTY

Infectious Diseases
Neurology
Nuclear Medicine
Oncology
Orthopedic Surgery
Pediatrics
Radiology

### INTENDED USERS

Health Plans
Hospitals
Managed Care Organizations
Physicians
Utilization Management

### GUIDELINE OBJECTIVE(S)

To evaluate the appropriateness of radiologic procedures in the differential diagnosis and evaluation of the limping child

### TARGET POPULATION

The limping child age 0-5 years

### INTERVENTIONS AND PRACTICES CONSIDERED

1. X-ray
    - Pelvis and lower extremity
    - Spine
    - Area of interest
2. Computed tomography (CT), area of interest
3. Magnetic resonance imaging (MRI)
    - Pelvis and lower extremity
    - Area of interest
4. Ultrasound (US)
    - Hip
    - Area of interest
5. Nuclear medicine (NUC) bone scan 3-phase of the lower extremity

### MAJOR OUTCOMES CONSIDERED

Utility of radiologic procedures in diagnosis and evaluation of the limping child

## METHODOLOGY

### METHODS USED TO COLLECT/SELECT EVIDENCE

Searches of Electronic Databases

## DESCRIPTION OF METHODS USED TO COLLECT/SELECT THE EVIDENCE

The guideline developer performed literature searches of peer-reviewed medical journals and the major applicable articles were identified and collected.

## NUMBER OF SOURCE DOCUMENTS

Not stated

## METHODS USED TO ASSESS THE QUALITY AND STRENGTH OF THE EVIDENCE

Weighting According to a Rating Scheme (Scheme Not Given)

## RATING SCHEME FOR THE STRENGTH OF THE EVIDENCE

Not stated

## METHODS USED TO ANALYZE THE EVIDENCE

Systematic Review with Evidence Tables

## DESCRIPTION OF THE METHODS USED TO ANALYZE THE EVIDENCE

One or two topic leaders within a panel assume the responsibility of developing an evidence table for each clinical condition, based on analysis of the current literature. These tables serve as a basis for developing a narrative specific to each clinical condition.

## METHODS USED TO FORMULATE THE RECOMMENDATIONS

Expert Consensus (Delphi)

## DESCRIPTION OF METHODS USED TO FORMULATE THE RECOMMENDATIONS

Since data available from existing scientific studies are usually insufficient for meta-analysis, broad-based consensus techniques are needed for reaching agreement in the formulation of the appropriateness criteria. The American College of Radiology (ACR) Appropriateness Criteria panels use a modified Delphi technique to arrive at consensus. Serial surveys are conducted by distributing questionnaires to consolidate expert opinions within each panel. These questionnaires are distributed to the participants along with the evidence table and narrative as developed by the topic leader(s). Questionnaires are completed by participants in their own professional setting without influence of the other members. Voting is conducted using a scoring system from 1-9, indicating the least to the most appropriate imaging examination or therapeutic procedure. The survey results are collected, tabulated in anonymous fashion, and redistributed after each round. A maximum of three rounds is conducted and opinions are unified to the highest degree possible. Eighty percent agreement is considered a

consensus. This modified Delphi technique enables individual, unbiased expression, is economical, easy to understand, and relatively simple to conduct.

If consensus cannot be reached by the Delphi technique, the panel is convened and group consensus techniques are utilized. The strengths and weaknesses of each test or procedure are discussed and consensus reached whenever possible. If "No consensus" appears in the rating column, reasons for this decision are added to the comment sections.

### RATING SCHEME FOR THE STRENGTH OF THE RECOMMENDATIONS

Not applicable

### COST ANALYSIS

A formal cost analysis was not performed and published cost analyses were not reviewed.

### METHOD OF GUIDELINE VALIDATION

Internal Peer Review

### DESCRIPTION OF METHOD OF GUIDELINE VALIDATION

Criteria developed by the Expert Panels are reviewed by the American College of Radiology (ACR) Committee on Appropriateness Criteria.

## RECOMMENDATIONS

### MAJOR RECOMMENDATIONS

**ACR Appropriateness Criteria®**

**Clinical Condition: Limping Child--Ages 0-5 Years**

**Variant 1: Nonfocal clinical exam.**

| Radiologic Procedure | Rating | Comments | RRL* |
|---|---|---|---|
| X-ray pelvis and lower extremity | 8 | Pelvis, femur (including knee), lower leg and foot are all imaged. | Min |
| NUC bone scan 3-phase lower extremity | 6 | Follow-up study when limping persists and radiographs negative. | Med |
| MRI pelvis and lower extremity | 6 | Follow-up study as needed. See comments regarding contrast in text under "Anticipated Expectations." | None |

| Radiologic Procedure | Rating | Comments | RRL* |
|---|---|---|---|
| US hip | 5 | Follow-up study as needed. | None |
| X-ray spine | 3 | | Low |
| **Rating Scale: 1=Least appropriate, 9=Most appropriate** | | | ***Relative Radiation Level** |

Note: Abbreviations used in the tables are listed at the end of the "Major Recommendations" field.

**Variant 2**: Focal clinical exam (not septic arthritis).

| Radiologic Procedure | Rating | Comments | RRL* |
|---|---|---|---|
| X-ray area of interest | 9 | Consider imaging region above and below area of concern. | NS |
| NUC bone scan 3-phase lower extremity | 7 | Follow-up study as needed. | Med |
| MRI area of interest | 7 | Follow-up study as needed. Use contrast as clinically indicated. See comments regarding contrast in text under "Anticipated Expectations." | None |
| US area of interest | 3 | | None |
| CT area of interest | 2 | | NS |
| **Rating Scale: 1=Least appropriate, 9=Most appropriate** | | | ***Relative Radiation Level** |

Note: Abbreviations used in the tables are listed at the end of the "Major Recommendations" field.

**Variant 3: Suspected septic arthritis.**

| Radiologic Procedure | Rating | Comments | RRL* |
|---|---|---|---|
| X-ray area of interest | 9 | | NS |
| US area of interest | 8 | Most useful at hip. | None |

| Radiologic Procedure | Rating | Comments | RRL* |
|---|---|---|---|
| NUC bone scan 3-phase lower extremity | 7 | Follow-up study as needed. | Med |
| MRI area of interest | 7 | Follow-up study as needed. See comments regarding contrast in text under "Anticipated Expectations." | None |
| CT area of interest | 2 | | NS |
| **Rating Scale: 1=Least appropriate, 9=Most appropriate** | | | ***Relative Radiation Level** |

**Summary of Literature Review**

Limping is a common clinical problem in childhood, and it can be a diagnostic dilemma. Limping is a specific type of gait abnormality due to pain. Typically, one must consider processes from the spine to the toes as potential causes of a limp, which makes the list of possibilities quite long. Children frequently are unable to accurately localize the source of pain, and when the pain is localized it may actually be referred from above or below the painful region, adding to the difficulty in diagnosis.

The conditions to be considered will depend in part on the patient's age. Common conditions leading to a limping child include soft-tissue or bone injuries; infection of the bone, soft tissues or joints; and neuromuscular, congenital, developmental, ischemic, and neoplastic processes.

In one prospective study of 243 children under 14 years of age presenting with a limp, the most common diagnosis was transient synovitis. There are many less common causes as well. The patient may have a self-limited problem, but could also have a traumatic, inflammatory, or neoplastic condition requiring diagnosis and treatment. Some entities such as septic arthritis require rapid diagnosis to prevent or limit adverse outcomes. Others can be diagnosed in a more temperate fashion, based on clinical course. A detailed history and complete physical exam are essential in assessing a child with a limp. In many cases, no imaging is required, while others may require extensive imaging evaluation.

No large prospective studies have been performed to evaluate imaging algorithms in the child presenting with a limp. However, studies have examined individual diagnoses that lead to this presentation. Even in children with trauma, there is discussion about the appropriate radiologic evaluation.

Plain-film radiography has been used extensively in evaluating the limping child. It allows for a rapid overview, and triage and is recommended in many imaging algorithms. Usually, radiographs of the entire lower extremity, including the feet, have been obtained due to the relatively high prevalence of occult fracture. However, studies by one group of investigators demonstrated that as many as

26% of lower-extremity radiographs in injured children could be avoided with only a 5% incidence of missed fractures if clinical criteria were used in selecting patients for radiography. Similarly, another group demonstrated that examination for gross deformity and pain on motion predicted lower-extremity fractures in the post-trauma setting, with 97% of children with fractures being correctly identified. In the limping child without a history of trauma, plain radiographs of the lower extremities are typically normal. Another group found that fracture was the cause of a limp in 20% of 500 preschoolers who presented with a limp, while another group found radiographic studies to be normal in 96% of patients presenting with limp, inability to bear weight, or frequent falling, and the few abnormalities identified were relatively insignificant. On the other hand, plain film is all that is required for detection of diagnoses such as slipped capital femoral epiphysis, permitting early surgical intervention.

Ultrasonographic evaluation has mainly been used in evaluating the irritable hip. Two groups of investigators found that ultrasound (US) was helpful as the primary imaging technique in transient synovitis, with radiography being unnecessary in uncomplicated cases. Another group found toxic synovitis to be the most common diagnosis in the child with a limp, and they routinely use US as the primary imaging modality, reserving plain film for cases where the US was negative. However, a false negative rate of 5% was reported in one study due to inadequate exams or very early scanning. Another group found similar findings, reserving radionuclide bone scans for those with positive findings on US. US guidance can also be useful in guiding joint aspiration to differentiate septic arthritis from toxic synovitis, particularly in the hip.

Aspiration is the gold standard in differentiating toxic synovitis from septic arthritis, but others suggest that not all effusions need to be aspirated. In a prospective study of 53 children who had undergone US-guided aspiration because of an irritable hip, one group of investigators found that fever, an elevated C-reactive protein level, an elevated erythrocyte sedimentation rate, lack of weight-bearing, and an elevated serum white-blood-cell count were predictors of septic arthritis. The probability of septic arthritis was estimated to be 98% when five predictors were present, 93% when four predictors were present, and 83% when three predictors were present. US can also detect alternate diagnoses such as osteomyelitis and Legg-Perthes disease.

Radionuclide bone scans have been shown to be efficacious in evaluating limping children younger than 5 years of age, particularly when the exam is nonfocal. One group of investigators studied patients without a history of infection, child abuse, malignancy, or radiographic abnormalities of the lower extremities and found that 30 out of 56 patients had abnormal bone scans. Another group studied a group of 50 patients who had no diagnosis after clinical, laboratory, and plain-films radiographic evaluation. They found that 54% of the patients had abnormal bone scans localized to a specific region. Bone scan also plays a role in diagnosis and prognosis in Legg-Calve-Perthes disease, where the scintigraphic finds may predict the severity of the disease progression. Fluorodeoxyglucose positron emission tomography (FDG-PET) imaging and leukocyte scintigraphy can be useful in chronic osteomyelitis, outperforming magnetic resonance imaging (MRI) and plain films in a study by another group.

Due to radiation concerns and the efficacy of other imaging modalities, the role of computed tomography is limited in the child with a limp. It can be useful in preoperative evaluation of known fracture and in identifying osteopenia in a small subgroup of children with negative MRI evaluation for stress fracture.

MRI is useful in a number of different conditions that lead to a limp in a child. It can detect many early stress fractures, detect early Legg-Perthes disease, and osteomyelitis. It may even help in differentiating toxic synovitis from septic arthritis, as bone marrow signal abnormalities are seen more commonly in septic arthritis. Whole-body MRI may also be helpful in children with multifocal lesions. MRI can also help in differentiating bone infarcts from osteomyelitis.

In summary, the evaluation of the child with a limp must start first with a detailed history and physical examination, including an analysis of gait. If the cause of limping is evident clinically (neuromuscular disease or minor trauma), further assessment may be unnecessary. If the patient's pain can be accurately localized clinically, appropriate radiographic views of the area should be obtained. However, if the source of the limp cannot be localized, a medical decision will first have to be made whether imaging assessment is initially required or if further clinical observation is appropriate. For patients who have persistent signs and symptoms, or a clinical assessment that points to the possibility of significant trauma, infection, or tumor as the cause of the problem, consideration should be given to performing additional plain films, US, MRI, or radionuclide bone scan.

**Anticipated Exceptions**

Nephrogenic systemic fibrosis (NSF, also known as nephrogenic fibrosing dermopathy) was first identified in 1997 and has recently generated substantial concern among radiologists, referring doctors and lay people. Until the last few years, gadolinium-based MR contrast agents were widely believed to be almost universally well tolerated, extremely safe and non-nephrotoxic, even when used in patients with impaired renal function. All available experience suggests that these agents remain generally very safe, but recently some patients with renal failure who have been exposed to gadolinium contrast agents (the percentage is unclear) have developed NSF, a syndrome that can be fatal. Further studies are necessary to determine what the exact relationships are between gadolinium-containing contrast agents, their specific components and stoichiometry, patient renal function and NSF. Current theory links the development of NSF to the administration of relatively high doses (e.g., >0.2 mM/kg) and to agents in which the gadolinium is least strongly chelated. The FDA has recently issued a "black box" warning concerning these contrast agents (http://www.fda.gov/cder/drug/InfoSheets/HCP/gcca_200705HCP.pdf).

This warning recommends that, until further information is available, gadolinium contrast agents should not be administered to patients with either acute or significant chronic kidney disease (estimated GFR <30 mL/min/1.73m$^2$), recent liver or kidney transplant or hepato-renal syndrome, unless a risk-benefit assessment suggests that the benefit of administration in the particular patient clearly outweighs the potential risk(s).

**Abbreviations**

- CT, computed tomography
- Med, medium
- Min, minimal
- MRI, magnetic resonance imaging
- NS, not specified
- NUC, nuclear medicine
- US, ultrasound

### CLINICAL ALGORITHM(S)

None provided

## EVIDENCE SUPPORTING THE RECOMMENDATIONS

### TYPE OF EVIDENCE SUPPORTING THE RECOMMENDATIONS

The recommendations are based on analysis of the current literature and expert panel consensus.

## BENEFITS/HARMS OF IMPLEMENTING THE GUIDELINE RECOMMENDATIONS

### POTENTIAL BENEFITS

Selection of appropriate radiologic imaging procedures for diagnosis and evaluation of the limping child

### POTENTIAL HARMS

- The relative radiation level is medium for nuclear medicine (NUC) bone scan 3-phase of the lower extremity and low for X-ray of the spine.
- Some patients with renal failure who have been exposed to gadolinium contrast agents (the percentage is unclear) have developed nephrogenic systemic fibrosis, a syndrome that can be fatal. Until further information is available, gadolinium contrast agents should not be administered to patients with either acute or significant chronic kidney disease (estimated GFR <30 mL/min/1.73m$^2$), recent liver or kidney transplant or hepato-renal syndrome, unless a risk-benefit assessment suggests that the benefit of administration in the particular patient clearly outweighs the potential risk(s).

## QUALIFYING STATEMENTS

### QUALIFYING STATEMENTS

An American College of Radiology (ACR) Committee on Appropriateness Criteria and its expert panels have developed criteria for determining appropriate imaging examinations for diagnosis and treatment of specified medical condition(s). These criteria are intended to guide radiologists, radiation oncologists, and referring physicians in making decisions regarding radiologic imaging and treatment. Generally, the complexity and severity of a patient's clinical condition should dictate the selection of appropriate imaging procedures or treatments. Only those

exams generally used for evaluation of the patient's condition are ranked. Other imaging studies necessary to evaluate other co-existent diseases or other medical consequences of this condition are not considered in this document. The availability of equipment or personnel may influence the selection of appropriate imaging procedures or treatments. Imaging techniques classified as investigational by the U.S. Food and Drug Administration (FDA) have not been considered in developing these criteria; however, study of new equipment and applications should be encouraged. The ultimate decision regarding the appropriateness of any specific radiologic examination or treatment must be made by the referring physician and radiologist in light of all the circumstances presented in an individual examination.

## IMPLEMENTATION OF THE GUIDELINE

### DESCRIPTION OF IMPLEMENTATION STRATEGY

An implementation strategy was not provided.

### IMPLEMENTATION TOOLS

Personal Digital Assistant (PDA) Downloads

For information about availability, see the "Availability of Companion Documents" and "Patient Resources" fields below.

## INSTITUTE OF MEDICINE (IOM) NATIONAL HEALTHCARE QUALITY REPORT CATEGORIES

### IOM CARE NEED

Getting Better

### IOM DOMAIN

Effectiveness

## IDENTIFYING INFORMATION AND AVAILABILITY

### BIBLIOGRAPHIC SOURCE(S)

Fordham L, Gunderman R, Blatt ER, Bulas D, Coley BD, Podberesky DJ, Prince JS, Tosi L, Expert Panel on Pediatric Imaging. Limping child--ages 0-5 years. [online publication]. Reston (VA): American College of Radiology (ACR); 2007. 5 p. [59 references]

### ADAPTATION

Not applicable: The guideline was not adapted from another source.

## DATE RELEASED

1995 (revised 2007)

## GUIDELINE DEVELOPER(S)

American College of Radiology - Medical Specialty Society

## SOURCE(S) OF FUNDING

The American College of Radiology (ACR) provided the funding and the resources for these ACR Appropriateness Criteria®.

## GUIDELINE COMMITTEE

Committee on Appropriateness Criteria, Expert Panel on Pediatric Imaging

## COMPOSITION OF GROUP THAT AUTHORED THE GUIDELINE

*Panel Members*: Lynn Fordham, MD; Richard Gunderman, MD, PhD; Ellen R. Blatt, MD; Dorothy Bulas, MD; Brian D. Coley, MD; Daniel J. Podberesky, MD; Jeffrey Scott Prince, MD; Laura Tosi, MD

## FINANCIAL DISCLOSURES/CONFLICTS OF INTEREST

Not stated

## GUIDELINE STATUS

This is the current release of the guideline.

The appropriateness criteria are reviewed annually and updated by the panels as needed, depending on introduction of new and highly significant scientific evidence.

## GUIDELINE AVAILABILITY

Electronic copies: Available in Portable Document Format (PDF) from the American College of Radiology (ACR) Web site.

ACR Appropriateness Criteria® *Anytime*, *Anywhere*™ (PDA application). Available from the ACR Web site.

Print copies: Available from the American College of Radiology, 1891 Preston White Drive, Reston, VA 20191. Telephone: (703) 648-8900.

## AVAILABILITY OF COMPANION DOCUMENTS

The following are available:

- ACR Appropriateness Criteria®. Background and development. Reston (VA): American College of Radiology; 2 p. Electronic copies: Available in Portable Document Format (PDF) from the American College of Radiology (ACR) Web site.
- ACR Appropriateness Criteria®. Relative radiation level information. Reston (VA): American College of Radiology; 2 p. Electronic copies: Available in Portable Document Format (PDF) from the American College of Radiology (ACR) Web site.


## PATIENT RESOURCES

None available

## NGC STATUS

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