



# Red flag rules for knee and lower leg differential diagnosis

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**Abstract:** Physical therapists can be frequently a patient's initial encounter after a lower extremity injury, as access to physical therapy services have become readily available without a physician's referral. In 2017, over 65% of physical therapy providers are treating via direct access in United States that allow unrestricted access. In addition to direct access, in an age when at least one of four Americans have multiple chronic medical conditions, it is vital to be able to perform a comprehensive examination, which includes a thorough patient history, systems review, and objective test and measures. Physical therapists should identify red flag symptoms and signs indicating possible pathological condition(s). Based on the findings, a clinical decision should be made to either treat the patient, refer the patient to an appropriate healthcare practitioner, or initiate both treatment and referral. If serious pathology is suspected, it is most prudent to refer the patient appropriately to a qualified medical practitioner.

**Keywords:** Red flags; differential diagnosis; physical therapy; fractures; deep vein thrombosis (DVT); peripheral vascular diseases (PAD)

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## Introduction

Physical therapists can be frequently a patient's initial encounter after a lower extremity injury, as access to physical therapy services have become readily available without a physician's referral. In 2017, over 65% of physical therapy providers are treating via direct access in United States that allow unrestricted access (1). In addition to direct access, in an age when at least one of four Americans have multiple chronic medical conditions, it is vital to be able to perform a comprehensive examination, which includes a thorough patient history, systems review, and objective test and measures (2). Physical therapists should identify red flag symptoms and signs indicating possible pathological condition(s). Based on the findings, a clinical decision should be made to either treat the patient, refer the patient to an appropriate healthcare practitioner, or initiate both treatment and referral (3). In any case, if serious pathology is suspected, it is most prudent to refer the patient appropriately to a qualified medical practitioner.

There are various pathologies to consider in the examination involving the lower extremity. However, it is important to be able to identify red flags for serious pathologies in that one may more realistically encounter in a physical therapy outpatient setting and may require an immediate referral. The conditions that will be discussed are: fractures of the knee, deep vein thrombosis, and peripheral vascular disease.

## Fractures of the knee

Serious fractures after trauma are easily identified and commonly evaluated by radiographic imaging in an emergency department. However, subtle fractures of lower extremity (excluding stress fractures) may present similar to a sprain or minor injury and can be easily missed during an examination. In a physical therapy setting, it is very common to evaluate acute knee and leg injuries, therefore it is important to be able to identify and rule out possible fractures (4).

### ***Red flag rules in patient history***

Recent history of trauma, such as motor vehicle accident, crush injury, sports-related injury, and a fall, as a mechanism of injury is a major red flag for suspicion of a fracture of the knee and lower leg. The presence of osteoporosis in a patient's medical history is another red flag that should raise one's suspicion of a fracture (5). Oftentimes, osteoporosis may not be officially diagnosed but a patient's age and gender should also be taken into consideration. Elderly women who are postmenopausal are at a higher risk for osteoporosis (6). Falls in a younger active population may not raise any concerns, but for an elderly individual who may be at risk for osteoporosis, a simple fall may result in a fracture. Considering these red flags, it should lead to further investigation during the physical examination.

### ***Red flag rules in physical examination***

The signs and symptoms of any trauma include hematomas, edema, and significant pain around the involved area. In addition to the obvious signs of trauma, there are other methods available to utilize for ruling out possible fractures of the knee. The Ottawa knee rules are commonly used for clinical decision making to determine whether radiographs are necessary after knee trauma (7,8). Studies have shown the Ottawa knee rules to be 100% sensitive for fractures and can easily be used in the clinic (9).

### ***The Ottawa Knee Rule (9)***

A knee X-ray series is only required for knee injury patients with any of these findings: age 55 or older OR isolated tenderness of the patella (no bone tenderness of knee other than patella) OR Tenderness of the head of the fibula OR cannot flex to 90 degrees OR unable to bear weight both immediately and in the emergency room department for 4 steps (unable to transfer weight twice onto each lower limb regardless of limping).

Tuning fork test is another method utilizing a 128-Hz tuning fork over the bony prominence distal to the suspected fracture. The vibration of the tuning fork on the bony prominence is theorized to cause the fracture site to move resulting in significant pain. The current evidence shows that there is some validity of using a tuning fork to rule out fractures but lacks support for ruling in fractures (10). Tuning fork test can be used in conjunction with other tests such as the aforementioned Ottawa knee rule to strengthen your hypothesis for possible fracture

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however it may be more appropriate for rural and remote settings where access to diagnostic imaging is limited.

### **Deep vein thrombosis (DVT)**

DVT is a condition when there is a presence of a blood clot in the deep veins, most commonly found in the lower extremity. Detection of DVTs can lead to the prevention of potentially fatal complications including pulmonary embolisms (11).

### ***Red flags in patient history***

There are three conditions, called Virchow's triad, which increase the risk of thrombus formation: endothelial injury, stasis or turbulence of blood flow, and blood hypercoagulability (11). There are many risk factors or red flags that will result in one or more of the three conditions. Below is a list of red flag items from a patient's history that may increase the risk for a DVT (11):

- ❖ Acute infection;
- ❖ Cancer;
- ❖ Stroke or paralysis;
- ❖ Previous DVT;
- ❖ Congestive heart failure;
- ❖ Pregnancy;
- ❖ Dehydration;
- ❖ Varicose veins;
- ❖ Nephrotic syndrome;
- ❖ Rheumatological disease;
- ❖ Acute inflammatory bowel disease;
- ❖ Recent major surgery;
- ❖ Hormonal treatment;
- ❖ Chemotherapy;
- ❖ Birth control pills;
- ❖ Prolonged immobility;
- ❖ Long air travel.

### ***Red flags in physical examination***

Patients with DVTs will have various clinical presentations and are asymptomatic most of the time. For those who are symptomatic can present with discoloration, pain, warmth, swelling, and tenderness of the affected extremity (11).

Homan's sign also has been widely used since the 1940s as an indicator for the presence of DVT in an extremity (12). A positive Homan's sign is pain and tenderness in the calf as the tester passively dorsiflexes the

**Table 1** Pretest probability assessment (Wells Score) (14)

Clinical feature	Points
Active cancer (treatment ongoing or within previous 6 months or palliative)	1
Paralysis, paresis, or recent plaster immobilization of the lower extremities	1
Recently bedridden for 3 days or major surgery within 12 weeks requiring general or regional anesthesia	1
Localized tenderness along the distribution of the deep veins	1
Entire leg swollen	1
Calf swelling 3 cm asymptomatic side (measured 10 cm below tibial tuberosity)	1
Pitting edema limited to the symptomatic leg	1
Collateral superficial veins (non-varicose)	1
Previous DVT	1
Alternative diagnosis as likely as or more likely than DVT	-2

DVT unlikely:  $\geq 1$ ; DVT likely:  $\leq 2$ . Reprinted from The Lancet, Wells PS, *et al.* (14), Copyright (1997), with permission from Elsevier.

ankle with the knee extended (12). Despite the popularity of this test, it has failed to be proven to be of any diagnostic value for the detection of DVTs in the clinic (12).

The recommended screening tool for DVTs is the Wells Score, which takes into account clinical presentation and risk factors for DVT (11). The initial Wells Criteria risk stratified patients into low-, moderate-, and high-probability groups (13). The most updated version was simplified into two probability groups: DVT unlikely and DVT likely (13). This tool has been validated for use in outpatient patients suspected of DVTs (*Table 1*) (14).

## Peripheral arterial disease

Peripheral arterial disease (PAD) is a condition in which there is a narrowing of arteries in the body outside of the heart, most commonly affecting the legs (15). It is estimated to be present in 20% of people of 60 years or older, ranging from asymptomatic reduction in distal limb pressures to limb-threatening disease (16). One of the common symptoms of PAD is intermittent claudication, which patients will complain of pain and cramping in the leg(s), commonly the calf with exertion or exercise and subsides with rest (16). This is especially important because it can be a differential diagnosis for a patient complaining of leg pain. Though PAD may not be immediately life-threatening, it is important to notify and refer back to the patient's primary care physician of suspected PAD but can result in limb-threatening disease if untreated (16).

## Red flags in patient history

There are many risk factors (medical history, current medications, nature of symptoms) to consider when suspecting PAD for a patient presenting with leg pain (*Table 2*) (16). Therefore it is vital to take a thorough history of the patient.

## Red flags in physical examination

The physical examination, including measuring range of motion, manual muscle testing, functional testing and special tests, should be unremarkable for reproduction of symptoms for patients who suspect to have PAD. However, a reproduction of symptoms (possible claudication) during a 6 Minute Walk Test may be present (17). This should lead to further clinical testing to strengthen your hypothesis.

Measuring ankle brachial index (ABI) is an inexpensive and non-invasive way to assess patient with potential PAD in the clinic (18). It is the ratio of the highest systolic blood pressures of the 2 legs (measured at the ankle) and 2 arms using the following equation (19):

$$\text{ABI} = \frac{\text{Highest ankle systolic blood pressure}}{\text{Highest brachial systolic blood pressure}}$$

There are various methods to measure ABI, however, in early PAD, the widely accepted method is oscillometric method and doppler (19). The ABI values greater than 1.4 indicates calcification/vessel hardening, 1–1.4 is considered normal, 0.9–1 is acceptable/borderline, and PAD can be present with values ranging from less than 0.4 to 0.9 (19).

**Table 2** Red flags in patient history for risk of PAD

Medical history	Drug history	Nature of symptoms
Coronary heart disease	Antihypertensives	Generalized leg pain (unilateral or bilateral) or cramping, commonly in the calf with exercise or exertion
Cerebrovascular disease (including transient ischemic attacks and stroke)	Cholesterol medication	Pain or cramping subsides with rest
Diabetes	Diabetes medication	
Hypertension		
Hypercholesterolemia,		
Family history of PAD		
Smoking		
Previous vascular procedures		
Cancer		
COPD		
Previous venous thromboembolic events		

## Conclusions

In physical therapy, it is essential to be able to perform a thorough examination of patients to identify red flags in order to generate a differential diagnosis for serious pathologies. There are no gold standard tests or measures to confirm and diagnose any suspected pathologies in a physical therapy outpatient setting. However, being able to recognize the necessary red flags in a patient history and physical examination is vital in order to initiate an immediate referral to their primary care physician or emergency department if a physician is unavailable. Since there is a lack of a validated process of identifying potential serious pathologies based on red flag findings, physical therapists must utilize their clinical decision making skills to establish an appropriate plan of care. If in any case there is suspicion of a serious medical pathology, communication with their primary care physician is always beneficial.

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## Footnote

*Conflicts of Interest:* The author has no conflicts of interest to declare.

*Ethical Statement:* The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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