

Clinical Prediction Rules for Diagnostic Imaging After Lower Extremity Trauma

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Clinicians utilize a variety of methods to determine which patients need diagnostic imaging following a traumatic injury to the lower extremity. In making such a clinical decision, a clinician's deductive reasoning may include consideration of patient feedback, previous experience, and published research evidence (Figure 1). A clinical prediction rule (CPR) is a powerful evidence-based tool that can support clinical decision making,

including determination of the need to refer an injured patient for diagnostic imaging.¹ A CPR is derived from statistical analysis of clinical data, which quantifies the predictive strength of a combination of variables (i.e., patient characteristics).² A well-validated CPR allows the clinician to accurately

predict the likelihood that a given condition exists or the likelihood that a specific treatment will yield a desired outcome.¹ Information derived from a comprehensive patient history and thorough physical examination can be related to a CPR for diagnosis of lower extremity pathology, thereby improving the outcomes of clinical decisions.

Diagnostic imaging is highly overutilized in the U.S.³ Unnecessary diagnostic imaging



Figure 1 Evidence-based practice paradigm.

of the lower extremity may be reduced by as much as 28% through the application of a CPR.^{4,5} Patient benefits include less waiting time in an emergency room and lowered medical costs. As reform of the U.S. healthcare system progresses, clinicians will be held increasingly accountable for patient outcomes and cost control. Therefore, there is a need to utilize the best available evidence to guide clinical decision making. The purpose of this report is to review CPRs that have been developed for the clinical assessment of foot, ankle, and knee injuries and evidence that supports their accuracy and the potential cost savings that could be realized from their utilization. The information provides the athletic trainer or therapist (AT) with clear guidelines for clinical decision making that relates to traumatic lower extremity pathology.

Terminology

To effectively utilize a CPR, an AT must become familiar with terminology that

KEY POINTS

▶ CPRs can reduce unnecessary imaging of lower extremity injuries.

▶ The Ottawa Ankle Rule, the Ottawa Knee Rule, and the Pittsburgh Knee Rule are highly accurate for identification of patients who do not need diagnostic imaging.

relates to its prediction accuracy.⁶ *Sensitivity* refers to the proportion of all positive cases that are correctly classified as positive by a particular clinical test or CPR, and *specificity* refers to the proportion of negative cases that are correctly classified as negative. Because a clinical test or CPR that has extremely good sensitivity does not miss very many positive cases, a negative classification is unlikely to be incorrect. The acronym SnNout relates to a negative result for a test that has high sensitivity (Sn), which strongly suggests that the patient does not have the condition (i.e., with high Sn, a negative result rules out the condition). A clinical test or CPR that has extremely good specificity does not often lead to misclassification of cases that are truly positive. Thus, the acronym SpPin relates to a positive result for a test that has high specificity (Sp), which strongly suggests that the patient does have the condition (i.e., with high Sp, a positive result rules in the condition). Both sensitivity and specificity are represented by a value that ranges from 0.00 to 1.00 (see Table 1).

Ottawa Ankle Rule

The Ottawa Ankle Rule⁷ was developed to assist clinicians in the determination of the need to obtain radiographs for a patient who has experienced ankle trauma. Although this rule was designed for use in hospital emergency rooms, it can certainly be applied to the setting in which an AT practices (Table 2). Application of the Ottawa Ankle Rule has been shown to have sensitivity = 0.98 and specificity = 0.32 for the general population.⁸ When applied to an athletic population, this CPR has been reported to have a sensitivity = 1.0 and a specificity = 0.40.⁸ Because the Ottawa Ankle Rule has extremely high sensitivity, its utilization has been estimated to result in a 30–40% decrease in radiographs.⁹ The Ottawa Ankle Rule can also be used by clinicians in determining the need to obtain radiographs for the patient who has experienced

TABLE 1. SPPIN & SNNOUT

SpPin	Test with high specificity (Sp) that yields a positive (P) result “rules in” the existence a condition with a high degree of accuracy.
SnNout	Test with high sensitivity (Sn) that yields a negative (N) result “rules out” the existence of a condition with a high degree of accuracy.

midfoot trauma (Table 3), which has been shown to have sensitivity = 0.99 and specificity = 0.38.⁹

Pittsburgh Knee Rule

Diagnostic imaging after knee trauma appears to be highly overutilized. One study reported that radiographs were ordered for 85% of patients who had sustained a traumatic knee injury, but only 6–12% of them were found to have a fracture.¹⁰ The Pittsburgh Knee Rule is useful in determining the need for diagnostic imaging following blunt knee trauma, including a fall on a flexed knee (Table 4), which has been reported to have sensitivity = 0.99 and specificity = 0.60.^{10,11} The high sensitivity of the Pittsburgh Knee Rule could reduce the amount of unnecessary radiographs by as much as 52%.¹⁰

Ottawa Knee Rule

The Ottawa Knee Rule was originally developed for patients over the age of 18,¹² but its use has also been validated for children between 2–16 years of age (Table 5).¹³

TABLE 2. OTTAWA ANKLE RULE

Conventional radiographs should be ordered after trauma to the ankle in patients who present the following characteristics.
Ottawa Ankle Rule
Pain over medial or lateral malleolus AND
Tenderness at posterior aspect of tip of medial malleolus OR
Tenderness at posterior aspect of tip of lateral malleolus OR
Inability to weight-bear immediately and at ER

TABLE 3. OTTAWA ANKLE RULE

Conventional radiographs should be ordered after trauma to the mid-foot in patients who present the following characteristics.
Ottawa Ankle Rule – Mid-Foot Application
Pain in the area of the midfoot AND
Tenderness over the base of the 5 th metatarsal OR
Tenderness at the navicular bone OR
Inability to weight-bear immediately and at ER