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## PREDICTORS OF CLINICALLY SIGNIFICANT RADIOGRAPHIC SHOULDER PATHOLOGY IN THE EMERGENCY DEPARTMENT

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**Abstract—Background:** Although there are no clinical decision rules for radiograph use among persons with shoulder pain, they are ordered for most patients. Previously published reviews have demonstrated that radiography is overutilized in evaluating emergency department (ED) patients with shoulder pain, and clinical factors might define patients in whom plain film radiography need not be performed. **Objectives:** The objectives of this study were to identify predictors of clinically significant shoulder pain and develop a clinical decision radiograph-ordering rule for adult ED patients with shoulder pain. **Methods:** Records from adult ED visits resulting in shoulder radiographs were reviewed. Potential predictors of clinically significant shoulder pain were then identified. Univariate screening was performed to find variables associated with injury and were subsequently included in a multivariable prediction model. **Results:** Five of the predetermined factors were found to be associated with the likelihood of injury: history of trauma, range of motion, deformity, age, and duration of pain. Receiver operating characteristics revealed an area under the curve of 80%. **Conclusions:** Despite accounting for multiple variables, the area under the curve was 80%. Based on these results it is not practical to develop clinical decision radiograph ordering rules for ED patients with shoulder pain. © 2015 Elsevier Inc.

**Keywords—**shoulder; fracture; radiation; radiographs; radiology; clinical decision rules

### INTRODUCTION

#### *Background*

Shoulder pain in adults, both acute and chronic, is a common cause for emergency department (ED) visits, accounting for 1–4% of ED admissions (1). Although there are no clinical decision rules for radiograph use among persons with shoulder pain, they are ordered for most patients. Not surprisingly, many radiographs are normal or nondiagnostic.

#### *Importance*

Clinical decision rules have been established to eliminate unnecessary x-ray studies in patients with ankle and knee injuries (2,3). The goal of these decision rules is to decrease length of stay, hospital and patient costs, and reduce unnecessary radiation exposure. Previously published reviews have demonstrated that plain radiography is overutilized in the evaluation of patients presenting to the ED with shoulder pain, and that clinical factors might define subgroups of low-risk patients in whom plain film radiography need not be performed as part of their initial evaluation (4,5). These studies also suggest that specific clinical criteria may be able to identify patients who do not need radiographs as

part of the initial management of shoulder pain in general practice (4,5). Despite this, no accepted criteria exist regarding the utilization of shoulder radiographs in the setting of shoulder pain.

### Goals

The objectives of this 5-year retrospective chart review are twofold: first, to identify predictors of clinically significant shoulder pain, and second, to develop clinical decision radiograph-ordering rules for ED patients with shoulder pain.

## MATERIALS AND METHODS

### Study Design and Setting

This institutional review board-approved retrospective chart review was conducted in the ED at Staten Island University Hospital, a 728-bed, tertiary-care teaching hospital in Staten Island, NY.

### Selection of Participants

Medical records of all adult ED admissions with shoulder radiographs between January 2004 and December 2008 were identified via a radiology picture archiving and communication system query. Inclusion criteria were patients aged 18 years or older, with a complete ED chart, a finalized x-ray study report, and a complaint of shoulder pain (of any etiology or duration). Study subjects were allowed to be enrolled more than once.

### Methods and Measurements

Each record was reviewed by two investigators: a trained research associate and a board-certified emergency medicine physician. Information was recorded using a standardized data collection sheet. Only charts with complete data were included. Demographic data included age, sex, race, and primary insurance type were obtained. Clinical data included history of prior injury to same shoulder or known shoulder pathology. Characteristics of pain recorded included duration and distracting injuries. Duration of pain was quantified, however, pain lasting longer than 30 days was considered chronic and not quantified. Presence of paresthesias, motor loss, sensory loss, swelling, erythema, ecchymoses, tenderness, limited range of motion, instability, deformity, or vascular compromise was documented. The mechanism of injury was classified into the following categories: assault, blunt trauma, exercise/sports, fall, lifting, motor vehicle accident, pulled, twisted, or nontraumatic. Clinical variables were chosen

for the study by the investigators based on their clinical experience and on previous studies (4,5). Radiographic diagnoses were obtained from computerized reports. All reports were dictated by a board-certified attending radiologist. Results were divided into the following classification: acromioclavicular dislocation (Grade 3 or higher), fracture, shoulder dislocation, indeterminate, or negative. Negative radiographs were those that did not require any acute intervention indicated in the ED. Grade 1–2 acromioclavicular dislocations were considered negative.

### Outcome

The primary outcome measure was the presence of clinically significant injury, requiring acute intervention in the ED, demonstrated on shoulder x-ray study. Clinically significant injuries included acromioclavicular dislocation (Grade 3 or higher), fracture, or shoulder dislocation.

### Statistical Methods

Univariate screening to find variables associated with injury, to be included in a subsequent multivariable prediction model, was carried out using the chi-squared test and Wilcoxon rank-sum test (for categorical variables and continuous variables, respectively). Variables that were significantly ( $p < 0.05$ ) associated with injury were included in a multiple linear logistic model. Variables were selected to remain in the model using the method of backward elimination. Receiver operating characteristic curves were constructed.

## RESULTS

The researchers identified 539 eligible subjects. Eighteen subjects were excluded due to missing values for the response or explanatory variables. The remaining 521 subjects were included in the final analysis. Table 1 shows the characteristics of the study population. The most common mechanism of injury resulting in an x-ray study was a history of fall (56%), followed by motor vehicle accident (16%). After radiographic examination, 127 patients (24%) were found to have clinically significant injuries. Only 24 patients reported prior injury (4%).

Univariate analysis revealed that history of trauma ( $p < 0.0001$ ), presence of swelling ( $p < 0.0001$ ), presence of tenderness ( $p = 0.0012$ ), limited range of motion ( $p < 0.0001$ ), presence of deformity ( $p < 0.0001$ ), and mechanism of injury ( $p < 0.0001$ ) were significant factors in identifying clinically significant injuries. However, sex, race, insurance type, isolated pain, paresthesias, ecchymoses, and history of preexisting injury were not independent predictors.

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