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X-rays for Acute Knee Injuries: Pre- and Post-Pittsburgh Decision Rules Implementation. A District General Hospital Experience

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SUMMARY

Background. We wanted to assess the number of unnecessary radiographs done for acute knee injury patients and the accuracy of the Pittsburgh decision rules.

Material and methods. A retrospective observational study was done to look at the acute knee injury patients presented to a district general hospital Accident and Emergency Department from August 2011 till August 2013. We assessed the following parameters: sex, age, mechanism of injury, weight-bearing status and incidence of fractures in patients subjected to plain radiograph. A prospective study was then done from April 2014-August 2014 following implementation of the Pittsburgh decision rules.

Results. 24% of the patients had knee X-ray, compared to 72.12% in the first cycle. 36.8% had fracture, compared to 6.1% first cycle, with 66.7 % reduction in x-rays. Pittsburgh decision rules sensitivity was 100% and specificity 85.3%, positive predictive value 45.8% and accuracy 87%.

Conclusions. 1. The Pittsburgh decision rules is highly sensitive, specific and accurate in determining the need of X-ray in acute knee Injuries. 2. We found that the Pittsburgh decision rules performs well in our hospital, which coincides with previously published literature.

Key words: knee Injuries, Pittsburgh decision rules

BACKGROUND

Knee injuries are common cases in the emergency department in the UK [1]. Standard emergency medicine textbooks imply that radiographs should be routinely obtained for every patient who presents with a knee injury [2]. Consequently, x-rays are among the most commonly ordered imaging studies for traumatic injury to the knee joint [3,4]. Almost 85% of patients with acute knee injuries undergo x-ray, with fracture identified in only 6 to 12% of them [3-6]. Various criteria have been described in the literature to reduce the unnecessary exposure to x-rays in acute knee injuries. In 1994, Seaberg et al, prospectively validated the Pittsburgh Decision Rules (PDR) in133 consecutive patients of all ages with knee injuries with 100% sensitivity and 80% specificity (Fig. 1) [7]. We attempt in our study to assess the number of unnecessary radiographs in acute knee injuries in a district general hospital setting before and after applying the PDR.

MATERIAL AND METHODS

Following institutional ethical approval, a retrospective observational study was conducted to look at the acute knee injury patients presented to our hospital from August 2011 till August 2013. We assessed the following parameters; sex, age, mechanism of injury, weight-bearing status and incidence of fractures in patients subjected to plain radiograph. Patients who were excluded are those who had total knee arthroplasty and follow-ups.

Between April and August 2014, we prospectively implemented the PDR.The attending A&E physicians assessed each patient and filled up a pro forma to establish whether x-ray was indicated or not (Fig. 2). All patients were followed up to obtain final diagnosis. Six A4 Posters were displayed on the A&E wall describing the study objective & PDR criteria. The data collected were analysed for diagnostic accuracy (sensitivity, specificity, positive predictive value) of the PDR as well as the rate of x-rays pre and post PDR implementation.

RESULTS

During the 2 year study period, 947 patients presented with acute knee injury. 54% of those were males and 46% were females. The mean age at presentation was 32.8 years. Regarding the mechanism of trauma, 51% sustained a twisting injury, 30% blunt trauma and 19% presented after a fall. 21% of patients were unable to weight-bear in A&E, 49% were able to weight-bear and 30% were able to weight-bear but with a limp. Of the 947 patients, 683 (72.12%) underwent x-ray of the knee; however, only 42 patients (6.1%) were found to have fractures .As regards the types of fractures, there were 19 patella, 10 supracondylar femur, 10 tibial plateau and 3 tibial spine fractures. 641 patients had no fractures and so were unnecessarily exposed to radiation.

Between April and August 2014, PDR was prospectively implemented on 200 consecutive patients (n=200) of all ages with acute knee injuries.96 were males and 104 were females with a mean age of 34.3 at presentation. 56% had the injury through blunt trauma or fall. 60% were able to bear-weight while 40% could not walk four steps in A&E.48 patients, or 24% of the cohort presented to A&E, had a knee X-ray. 22 patients (45.8%) had fracture, and so there was a 66.7% reduction in x-ray (Table 1). The fractures detected post PDR implementations were; 10 tibia plateau, 8 patella and 4 distal femur fractures. PDR sensitivity was 100% and specificity 85.3%,

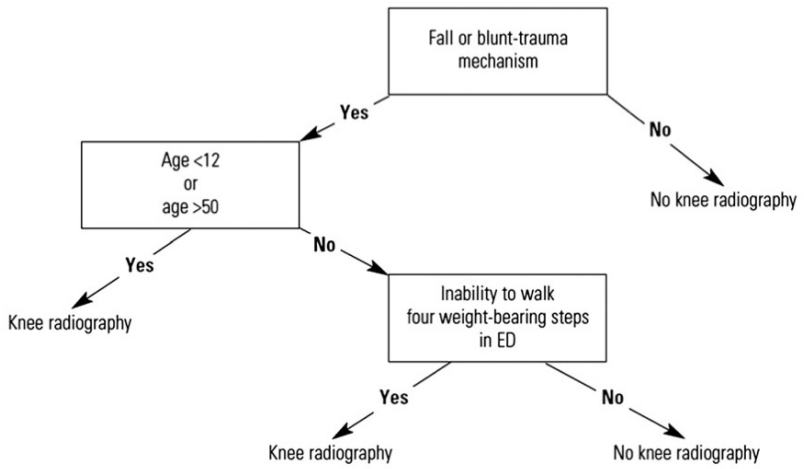

Fig. 1. Pittsburgh decision rules

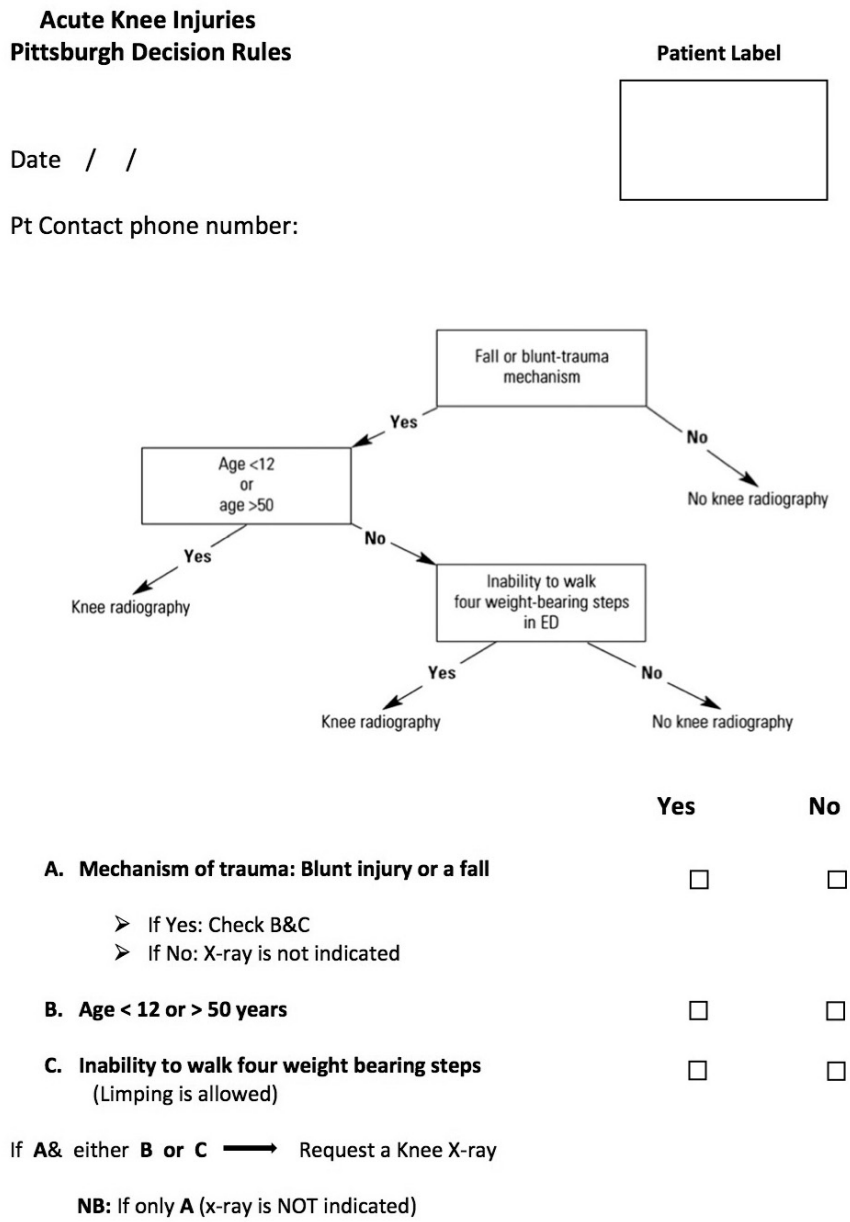

Fig. 2. Pro forma filled up by A&E physician to determine whether x-ray is indicated as per PDR

Tab. 1. Percentage of x-rays and fracture incidence

	Before PDR implementation	After PDR implementation
Patients underwent x-ray	72.12%	24%
Incidence of fracture	6.1%	45.8%

Tab. 2. Performance of PDR in detecting fractures

	Fracture	No Fracture
PDR positive	22	26
PDR negative	0	152

PDR: sensitivity 100%, specificity 85.3%, PPV 45.8%, Accuracy 87%, n=200, n= Total number of patients

positive predictive value (PPV) 45.8% and accuracy 87% (Table 2). Within one week, a senior member of the orthopaedic team in the fracture clinic assessed all the 152 patients who did not have an x-ray to ensure that no fractures were missed. Of the 152, 13 patients underwent Magnetic Resonance Imaging (MRI). 7 patients had ligamentous injuries and 6 had meniscal injuries on MRI.

DISCUSSION

Researchers have been working for years to find protocols that may reduce the number of radiographs used in the assessment of extremity injuries. Radiologic evaluation of knee injury protocols has also been designed [7-9]. The Ottawa and Pittsburgh clinical decision rules have the largest validation cohort in determining the need of x-ray in acute knee injuries [1,2]. The University of Ottawa conducted a retrospective chart review of all patients with acute knee injuries who presented to an emergency department over a 10-month period [5]. 74% of these patients had an x-ray done, but only 5.2 percent were found to have fractures. All 11 clinical variables: age, gender, mechanism of injury (blunt trauma or fall versus twisting), history of swelling, history of deformity, ability to ambulate (i.e., to walk four steps), ligamentous instability, decreased range of motion, swelling, effusion and pain on palpation, were assessed. Regression analysis found that the mechanism of injury involving a fall or a blunt trauma had a specificity of 57% and a sensitivity of 92% for the presence of a knee fracture [5]. The addition of age (younger than 12 years and older than 50 years) and inability to ambulate improved the specificity.

The PDR was developed in 1994 from a two-phase study [1,7,10]. Logistic regression to review the clinical indicators of 201 patients retrospectively was phase one, while phase 2 was a prospective study of 133 patients presenting with a knee injury. All patients were followed up with radiography to confirm the clinical diagnosis. Reliable indicators of a fracture were identified as patient age, mechanism of injury, and inability to ambulate. When combined to make the Pittsburgh rules, the specificity was found to be 80% with a sensitivity of 100% [10].

Various studies have compared the Ottawa and Pittsburgh decision rules [11-14]. In general, the Ottawa rules are better validated across a wider sample of adult patients. Whereas the Pittsburgh rules can be used for all ages. Furthermore the Ottawa rules were not designed for use in patients under the age of 18 years. In the paediatric population, the Pittsburgh rules have been found to be more sensitive [12]. The Ottawa and Pittsburgh rules used different definitions for the inability to bear weight. The Pittsburgh criteria were more stringent, requiring patients to take four full steps, applying weight to both the heel and toe pads. The Ottawa criteria, however, state that any weight transfer is considered bearing weight [12-14]. In the prospective multicenter study by Seaberg et al, PDR had a higher sensitivity than OKR 99% compared to 97% respectively, as well as significantly higher specificity of 60% for PDR and 27% for OKR [10,13]. In a recently published study by Tung C, et al, PDR was found to have significantly higher specificity 51%, compared to OKR rules 27%, with equal pooled sensitivity 0.86 [14]. Our study confirms that it is safe to use the PDR to minimize unnecessary radiation exposure in acute knee injuries with 100% sensitivity.

CONCLUSION

PDR is highly sensitive, specific & accurate in determining the need of X-ray in acute knee Injuries. We found that PDR performs well in our hospital, which coincides with previously published literature.

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