

Clinical Study

Assessment of Posterior Cruciate Ligament Injury Using the Merchant View

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Abstract *Purpose.* The aim of this study is to identify a radiological diagnosis of PCL injury using standard, easily obtained plain radiographs. *Methods.* Between January 2009 and December 2012, 34 patients met study inclusion criteria. Retrospective evaluation was performed on radiographs with patients demonstrating a PCL injury. Findings on the merchant view were correlated with clinical examination, magnetic resonance imaging (MRI), and intraoperative findings. The exclusion criteria were other associated ligamentous injury to either knee, prior surgery to either knee or an abnormal contralateral knee. A control group of 40 patients with PCL intact knees was also assessed. Measurements were made on the merchant view to describe a radiological sign, the “tibial drop off”. *Results.* Thirty four patients fulfilled the inclusion criteria. Patients with a definitive PCL rupture clearly demonstrated asymmetry in the tibial drop off between the injured knee and the normal knee. This difference was present in all injured patients. The mean PCL injured knee tibial drop off was 16.59 mm (SD 2.69), compared to 3.74 mm (SD 1.02) in the uninjured knee. This difference was highly statistically significant ($P < .01$). There was no difference in the tibial drop off between knees in the control group and no difference between the control group and the normal knee in the PCL injured group ($P = .34$). *Conclusion.* Injury to the PCL can be identified on the merchant view obtained as part of the standard knee series radiological assessment. This investigation is readily available to all clinicians and may help guide treatment and further imaging.

Keywords posterior cruciate ligament (PCL); merchant view; tibial drop off

1. Introduction

The diagnosis of posterior cruciate ligament (PCL) injuries has been improved with increasing awareness and specialist imaging yet delays in diagnosis or missed diagnosis still frequently occur [1, 2, 3, 4, 5, 6, 7].

Primary care physicians often rely on a magnetic resonance imaging scan (MRI) to make the diagnosis of PCL injury when clinical diagnostic uncertainty exists. Symptoms of a PCL injury may be vague with regards to a history of instability and, in chronic cases, patellofemoral symptoms may predominate. This leads to delay in treatment and diagnosis.

Most specialist knee surgeons would agree that higher-grade isolated PCL injuries should be treated with dynamic bracing [8, 9], but these braces need to be applied in the acute phase following PCL injury. A delay in diagnosis may therefore miss this window of opportunity for conservative management and increase the likelihood of surgical intervention in the future.

Most injured knees are initially investigated with plain radiographs. A standard series includes an anterior-posterior (AP), lateral and possibly a skyline (unilateral axial patellofemoral) view. A bilateral patellofemoral axial view (merchant view) may demonstrate posterior displacement of the tibia in a PCL injured knee compared to the normal side [10, 11, 12, 13]. This is an easy investigation to perform and interpret, such that a clinician inexperienced in managing knee ligament injuries can make a precipitous diagnosis.

2. Methods

We reviewed the files and imaging of 149 consecutive patients treated for PCL-related injuries in our clinic between 2009 and 2012. The inclusion criteria were that of an adequate merchant view; age between 18 and 50; acute isolated PCL injury; a normal contralateral knee; absence of previous surgery or injury to either knee; an MRI scan confirming isolated PCL injury (confirmed also in instances where surgery occurred). The exclusion criteria were that of prior ligament injury to either knee including chronic healed PCL injuries; prior surgery to either knee; metabolic or inflammatory disorders affecting the knee. After the inclusion criteria were fulfilled, 34 patients were eligible for the study. There were 25 males and 9 females. The average age was 31 years old (range 19–49). There were 18 left PCL injuries and 16 right.

A control group of 40 patients from the same period had been investigated for knee pathology not involving the

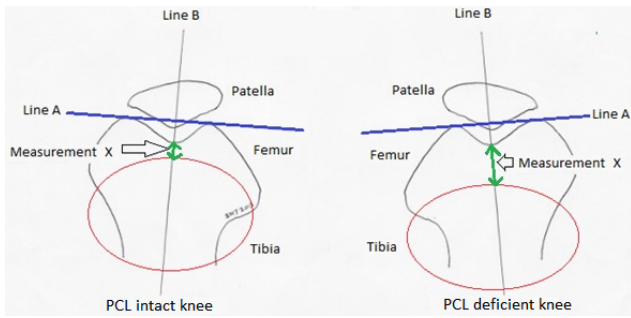


Figure 1: The measurements are made from the plain radiographs of both knees on the same film. Line “A” (blue) tangential to the femoral condyles. Line “B” (black) is perpendicular to line “A” passing through the deepest part of the trochlear groove. Measurement “X” (green arrowed lines, measured in millimeters) is made from the deepest part of the trochlear groove to the anterior tibial cortex (red oval).

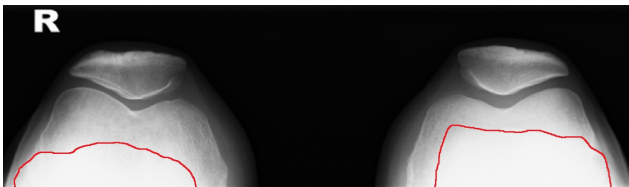


Figure 2: Showing the “tibial drop off” sign on the right PCL deficient knee. The red line outlines the anterior tibial cortex.

cruciate ligaments, or any significant internal derangement of the knee confirmed by MRI scan. This group had a standard series of knee radiographs including a merchant view. A merchant view (imaging both patellofemoral joints in the axial view on the same film) is obtained by placing the patient supine with the knees flexed to 40 degrees over the end of the table. The film cassette (image receptor) is placed between feet and knees. The central radiological beam is perpendicular to the image receptor. The central ray is then angled caudad 30 degrees from horizontal, with the central ray aimed between the patellae.

The merchant view can be useful in the assessment of posterior tibial displacement, using a previously published protocol [12]. A line is drawn tangentially between the highest points of the anterior femoral condyles (Figure 1; line “A”). A second line is then drawn at 90 degrees to the first line passing through the deepest part of the trochlear groove (Figure 1; line “B”). The distance from the trochlear groove to the intersection of this line with the anterior tibia is calculated (Figure 1; measurement “X”). The side-to-side difference is then calculated in millimeters. This can be described as the “tibial drop off” sign (Figure 2).

Table 1: Raw data tibial drop off PCL deficient knee versus contralateral injured side (mm).

Patient	Normal tibial drop off (mm)	PCL deficient knee tibial drop off (mm)
1	4	20
2	3	16
3	3	12
4	6	18
5	3	15
6	4	19
7	5	15
8	2	13
9	5	15
10	3	17
11	3	16
12	2	16
13	5	21
14	3	19
15	4	12
16	5	20
17	5	19
18	3	18
19	6	19
20	4	14
21	3	12
22	4	17
23	3	18
24	4	19
25	3	20
26	4	19
27	3	14
28	3	13
29	4	12
30	3	17
31	3	17
32	5	18
33	3	19
34	4	15

All measurements were made by a fellowship trained knee surgeon to ensure reproducibility in measurements, using the same PACS system measurement tools.

Statistical analysis for this study was performed using the student *t*-test. Significance was set at $P < .05$.

3. Results

Thirty four patients fulfilled the inclusion and exclusion criteria. There was no statistical difference between the demographics of the study group and the control group.

In the study group, with a definitive PCL rupture, a difference in tibial drop off between the injured knee and the normal knee was present in all patients. The mean tibial drop off in the uninjured knee was 3.74 mm (1.02 SD), and in the PCL deficient knee was 16.59 mm (2.69 SD), shown in Table 1, $P < .0001$. The average difference of measurement X, between the injured knee and the uninjured knee was 12.85 mm.

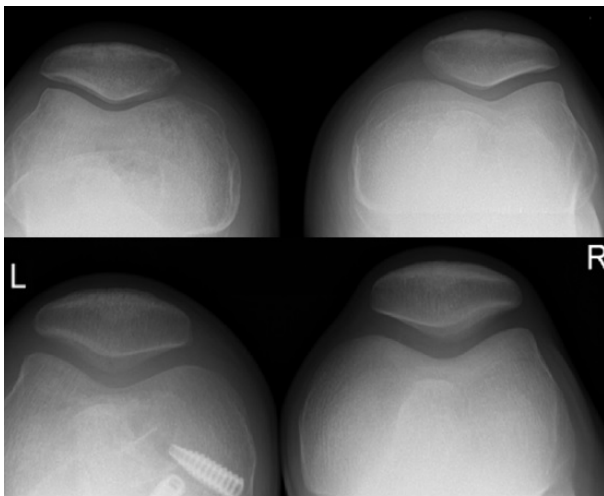


Figure 3: Merchant view demonstrating restoration of the tibial drop off sign (LARS PCL in situ).

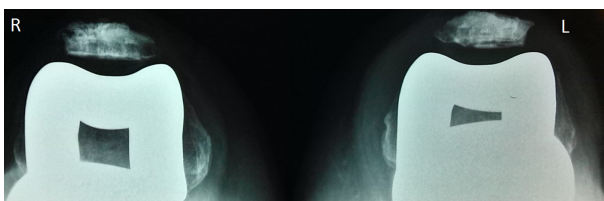


Figure 4: Radiograph showing PCL deficiencies in cruciate retaining knee arthroplasty.

The mean difference in tibial drop off between the knees in the control group was 0.23 mm, $P = .24$. There was no statistical difference between the control group and the normal knee in the PCL injured group, $P = .34$.

4. Discussion

PCL injuries can be difficult to diagnose. Where doubt exists, performing a radiographic knee series with merchant views of both patellofemoral joints can assist in the diagnosis. The “tibial drop off” sign does not require stress radiography and exposure of the clinician or radiographer to radiation (as previously described in the literature) [14, 15].

This study demonstrates that a merchant radiograph taken as part of a standard radiographic knee series may offer substantial information with regards to the integrity of the PCL. This study uses clinical findings as well as MRI and intraoperative findings to confirm the diagnosis of injury to the PCL.

When the PCL is reconstructed, success of restoration of the normal laxity and anatomy can also be assessed using this technique (Figure 3). It is particularly useful where metal screws/staples or similar hardware have been used during the reconstruction, rendering MRI ineffective due to artefact creation.

In patients who have undergone cruciate retaining total knee arthroplasty, this investigation may allow visualization of the tibia through the “open box” design of the femoral component which accommodates the PCL. In patients where stability may be an issue following a cruciate retaining knee arthroplasty, this investigation may therefore be of assistance as an incompetent PCL will be demonstrated; as shown in Figure 4. This particular use of the merchant view would require further study due to the inherent problems of obscuring the tibia with the femoral component as previously mentioned [16].

Further work may involve establishing a correlation between the size of the tibial drop off and the grade of the PCL injury. The tibial drop off sign could therefore help determine appropriate management of these injuries.

The limitations of this study are that it was performed in retrospect. More than one surgeon reviewed the patients in the study, however all surgeons worked in the same tertiary referral unit. Similarly, the imaging was performed by different radiographers working in the same department, so slight variations in technique may have occurred.

5. Conclusions

The merchant view offers a radiological opportunity to assess the knee with regard to suspected PCL injury. A significant difference in tibial drop off on the merchant view should alert the clinician to the possibility of an acute PCL injury which may then require further imaging or onward referral.

Conflict of interest The authors declare that they have no conflict of interest.

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