Patient-Directed Valgus Stress Radiograph of the Knee: A New and Novel Technique

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Abstract

The radiographic investigation of patients with medial-compartment osteoarthritis of the knee is a critical element in the decision-making process of determining whether the patient is a candidate for unicompartmental or total knee arthroplasty. A valgus stress radiograph of the affected knee is an essential part of this radiographic investigation. Historically, this has been performed with manual stress applied by the surgeon or the radiologic technologist; thus, this examination requires 2 individuals to complete. In addition to being inefficient, 1 individual is exposed to radiation, which can be undesirable over many exposures and in a long career.

For these reasons, we instituted a quality improvement project to develop a method of obtaining the valgus stress view with 1 technologist that would obviate these concerns. Of 78 examinations performed, 5 studies did not show complete correction of the varus deformity. Of these, 3 showed complete correction on a manual valgus stress radiograph, and 2 did not. Three patients displayed collapse of the lateral compartment, indicating a nonfunctional lateral compartment. The remaining 70 patients had identical radiographic results with both the manual and patient-directed valgus stress.

Medial-compartment partial knee arthroplasty (unicompartmental replacement) is an accepted surgical intervention for anteromedial osteoarthritis of the knee.[1] The radiographic investigations required in the workup of these patients should include weight-bearing standing anteroposterior (AP), lateral, and sunrise (Merchant) views, as well as a valgus stress AP radiograph to assess the functionality of the lateral compartment. The method of properly obtaining the valgus stress film has been well described by the Oxford Group.[2] Its recommended radiographic technique requires that a surgeon or a radiologic technologist perform the valgus stress maneuver, manually, while another technologist shoots the film. The 2 consequences of this technique are that it requires 2 individuals to obtain the film, and it subjects the individual who is applying the stress to some level of radiation exposure, which is undesirable. Because of this and the time inconvenience, many surgeons omit the valgus stress radiograph, which can lead to the adverse outcome of missing a lateral compartment that is functionally incompetent, resulting in the potential for early lateral compartment progression of osteoarthritis and the need for revision surgery, usually to a total knee arthroplasty.

In an attempt to mitigate these barriers to obtaining the necessary valgus stress radiograph, Dr. Mauerhan's team developed a technique that could be done with the assistance of the patient and would require only 1 technologist to perform. Additionally, this project was a quality improvement initiative, because it lowered radiation exposure to all personnel involved in obtaining the correct films.

Materials and Methods

We initiated the project using weight-bearing strategies to impart the valgus stress view of the knee. After trying several different wedges and blocks, and varying patient instructions, we realized a different approach to this problem would be required to find an acceptable solution. We redirected our efforts to effectively performing the stress view with the patient in a supine position on the radiograph table. Ultimately, we decided that a much stiffer wedge and a denser object to squeeze would facilitate obtaining a proper film. Considering all available options, a youth size 4 soccer ball (diameter, 11 in) was introduced along with a slightly larger positioning wedge. The soccer ball was wrapped with 4-in Coban wrap (3M) to create a nonslip surface. This change in patient positioning, along with a standardized 7° to 10° cephalic radiographic tube angulation, helped to correct issues with tibial plateau visualization. Once these changes were enacted, we obtained fairly consistent positive results, and we instituted this patient-directed valgus stress view of the knee, along with a manual valgus stress view for comparison.

The protocol for obtaining the patient-directed valgus stress view of the knee is as follows: The patient lays supine with a dense 45° spine-positioning wedge (Burlington Medical Supplies) placed under both knees and the patient's heels on the examining table. The radiographic tube is angled cephalad 7° to 10° centered on the inferior pole of the patella, using a

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40-in source to image-receptor distance, collimated to part; the image receptor is placed under the affected knee, below the positioning wedge. The affected knee is rotated to the "true" AP position (the patella will be centered between the femoral condyles on the AP exposure), and the ball is placed between the patient's legs just above the ankle joint. The technologist demonstrates to the patient how to squeeze the ball while maintaining contact of heels with the table. The technologist can exit the room and obtain the exposure, which is taken while the patient is squeezing the ball, as shown in **Figures 1A and 1B**. Examples of the standing AP, manual stress, and patient-directed valgus radiographs are shown in **Figures 2A-2C**. The entire technique is demonstrated in the **Video**, which is available online at www.amjorthopedics.com.

Results

During the 9 months of this quality improvement project, 78 examinations were performed. Five studies did not show complete correction of the varus deformity. Of these, 3 showed complete correction on a manual valgus stress radiograph, and 2 did not, contraindicating the use of partial knee replacement.

Figure 1. (A) Patient positioned on table. (B) Patient squeezing ball, with beam centered on inferior pole of patella.

Three patients displayed collapse of the lateral compartment, indicating a nonfunctional lateral compartment, and, therefore, were also a contraindication to partial knee arthroplasty. The remaining 70 patients had identical radiographic results with both the manual and patient-directed valgus stress tests. There was no instance of examination failure or need to repeat as a result of difficulty of the examination for the patient. Repeat films because of positioning errors were very rare, usually early in the learning curve, and no more prevalent than when using the manual stress method. The technique was reproducible and easy to teach and adopt.

Discussion

In total, 73 patients (93.5%) with the patient-directed stress film showed the desired result, either correction of the medial compartment narrowing in conjunction with an intact lateral compartment or narrowing of the lateral compartment. Of the 5 patients (6.5%) whose patient-directed stress films did not show correction of the varus deformity, 3 patients displayed correction with a manually applied stress radiograph and 2 did not. Based on this observation, our recommendation would be for those patients who do not show adequate correction on the patient-directed stress radiograph to have a manual examination to establish the presence or absence of the desired correction.

Performing a valgus stress radiograph is an integral part of the investigation to determine if the patient is an appropriate candidate for partial knee arthroplasty.[3] The historical, manually performed valgus stress radiograph requires 2 individuals, 1 to apply the stress with the patient on the table and 1 to shoot the exposure. For the individual or individuals applying this stress, there is an increased radiation exposure that would be undesirable over a long career. The authors developed a new technique using a commercially available spinal positioning wedge and 11-in youth soccer ball wrapped with Coban wrap, as described, which is economical and easy to obtain and use in the clinical setting. We believe this cost-effective method will offer surgeons who perform partial knee arthroplasty a novel method to obtain the important

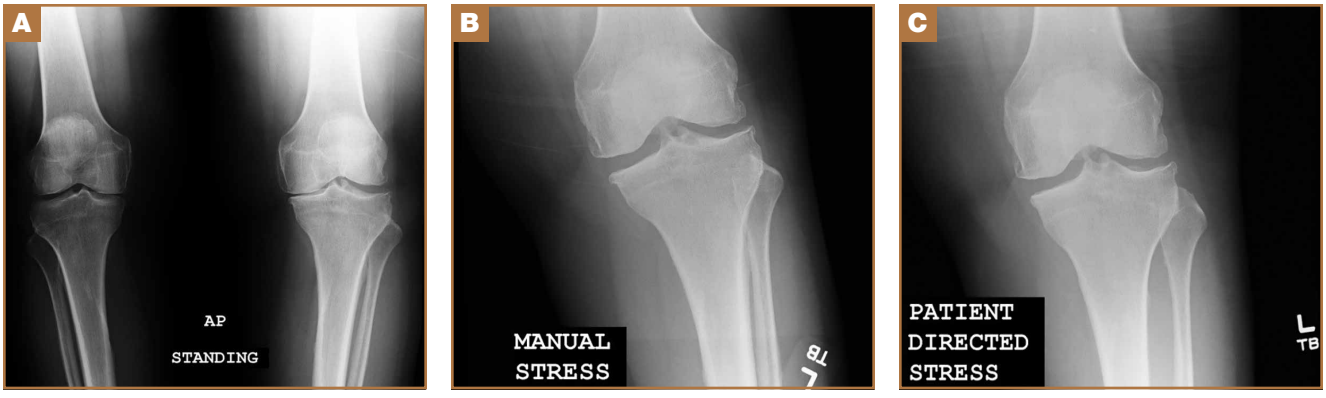

Figure 2. (A) Standing anteroposterior radiograph of knees. (B) Manual stress view of left knee. (C) Patient-directed stress view of left knee.

information gleaned from the valgus stress radiograph and to improve surgical outcomes through the preoperative assessment of the lateral compartment. Additionally, as a quality and safety improvement initiative, we believe this technique will reduce radiographic exposure for those performing these studies, and, because the examination can be carried out by a single technologist, it will significantly improve efficiency in the radiology suite.

Conclusion

We have developed a new method of obtaining the important valgus stress radiograph as part of the workup of patients with medial-compartment osteoarthritis of the knee. The technique can be performed with easily obtainable, commercially available products and is reliable 93.5% of the time. It also adds to the efficiency of the radiology suite and reduces radiographic exposure for technologists.

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