Holmblad Variations

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In Chicago during the summer of 1936, Edward C. Holmblad, M.D., was perplexed about the complexities involved in making an accurate knee diagnosis. He was concerned because specific pathologic conditions of the knee, though clinically present, did not show up on the x-ray studies. Specifically, he often suggested that "joint mice" could not be demonstrated on the traditional posteroanterior (PA) and lateral views. He attributed this problem to the overlapping shadow of the patella and the complex anatomy of the distal femur. Specifically, the intercondylar notch located posteriorly between the 2 distal condyles of the femur made it difficult to visualize osteophytes and "joint mice" in this region. He was frustrated because fractures involving the tibial spines and the proximal portion of the tibia were hard to evaluate radiographically. He approached this problem with the hope of improving the way radiographs of the knee were performed. As a result, in February 1937 Holmblad's research culminated in the Holmblad method, a position that is still known today.[1,2]

When describing this position, Holmblad said, "It is taken posteroanteriorly with the knee flexed 75°, the tibia nearly paralleling the top of the table. In cases where there is limitation of ankle motion, the foot is permitted to hang over the end of the table, thereby maintaining the lower leg parallel to the top of the cassette or film."[3] The position is unique because it requires the patient to kneel on the exam table. (See Fig. 1.) Interestingly, his description of the archaic equipment of the day was alarming. He said, "A word of caution is given to those not yet provided with shock proof equipment. The danger of having an exposed wire within sparking distance of the buttocks should be avoided. This can be done by raising the tube and increasing the distance from the tube to the film."[3] Gratefully, modern x-ray equipment has eliminated this life-threatening risk.

One exceptional feature of modern equipment is the elevating exam table. Because of this feature, patients no longer struggle to get onto exam tables; conveniently, x-ray tables can now be lowered to the height of the smallest patient. This development led to more resourceful and practical ways to perform the Holmblad method. What's more, this position also can be made easier with the aid of equipment that is readily available in most imaging departments.

This article describes 4 alternate ways to perform this PA projection. These methods are very similar to Holmblad's original method; however, adjustable height tables and locking wheelchairs help obtain the same results with less effort. Nonetheless, it should be noted that the methods discussed in this article are reserved for the cooperative ambulatory patient. The Béclere method, which will not be discussed, should be used for cases that require an anteroposterior

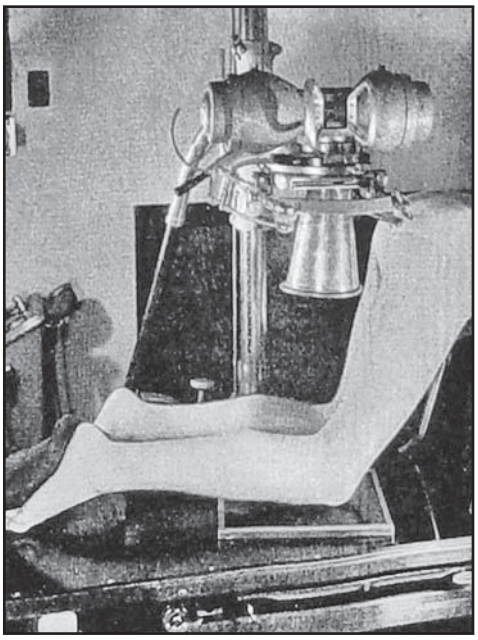

Fig. 1. *Holmblad method. Original illustration of the intercondylar notch position. (Digitally enhanced by Dan Hobbs. Reprinted with permission from Holmblad EC. Posteroanterior x-ray view of knee in flexion.* JAMA. *1937;109(15):1196.)*

(AP) projection. Before embarking on this endeavor, a brief review of the knee anatomy is presented followed by a description of joint mice and osteophytes.

Anatomy Review

Radiographically, the knee is one of the most difficult joints in the human body to demonstrate. The many soft tissue structures and the deep intercondylar fossa account for this complexity. The knee is composed of several bony and soft tissue components. The bony anatomy includes the distal femur, patella, proximal tibia and fibula. Additionally, the joint is stabilized by collateral, anterior and posterior ligaments. The modality of choice for demonstrating soft tissue structures is magnetic resonance (MR) imaging. Likewise, conventional radiography is used to evaluate the bony structures.

Damage to the ligaments can occur from either a direct or indirect force applied to the knee. To protect the knee from damage, the anterior quadriceps and the posterior hamstring muscles help support the knee joint, but it is the ligaments that provide stability. Furthermore, the menisci act as shock absorbers, dissipating force as the condyles of the femur articulate with the tibial plateaus. A graphical representation of this anatomy is included. (See Fig. 2.)

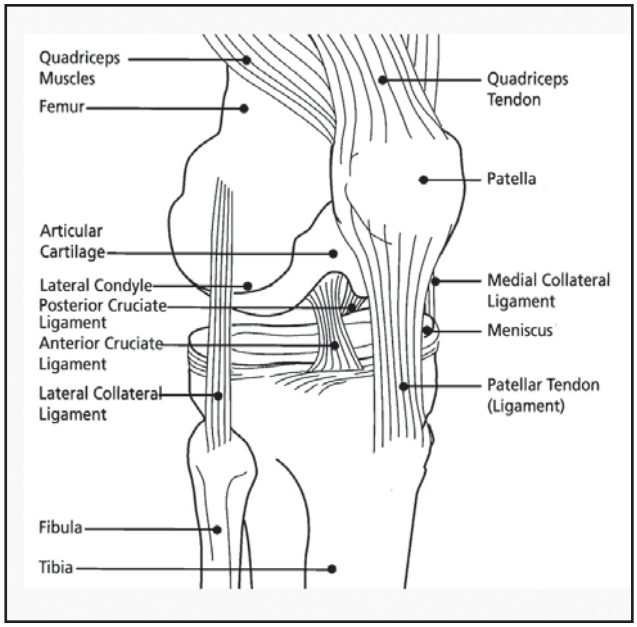

Fig. 2. *Bony and soft tissue anatomy of the knee.*

Joint Mice and Osteophytes

During his research, Holmblad described how difficult it was to visualize small foreign bodies such as joint mice and osteophytes. Imaging these foreign bodies was the impetus for his investigation. Joint mice can be described as loose pieces of bone or cartilage that have torn off the bone. Alternately, osteophytes are commonly known as bone spurs or bony overgrowths. These bone spurs can break off. When this happens, they often lodge in the joint and are then called joint mice. Because of the complex anatomy of the knee, sometimes these small foreign bodies cannot be seen on traditional PA and lateral projections.

What is more, a disease process such as osteochondritis dissecans can be better evaluated with nontraditional positions such as the tunnel projection. (See Fig. 3.) It is impracticable for even the radiologist

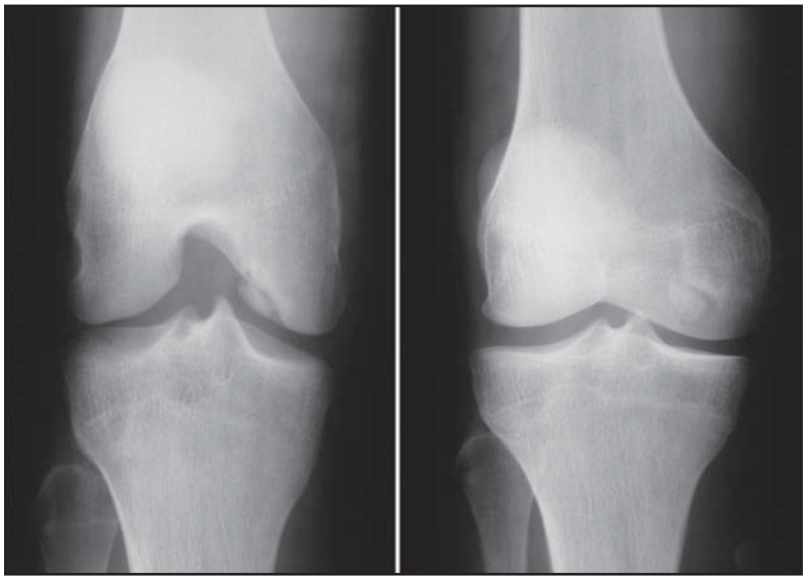

Fig. 3. *AP and tunnel projection of the knee. Osteochondritis dissecans of medial femoral condyle. This elliptical fragment of bone is separated from the surface of the medial condyle but does not lie freely within the joint. Once the fragment becomes separated, it becomes a loose fragment or joint mouse. This fragment is best demonstrated on the tunnel projection, which is the image on the left. (Image courtesy of William Herring, M.D., Albert Einstein Medical Center, Philadelphia, Pa, LearningRadiology.com Web site.)*

Fig. 4. *Partially standing. This position uses an elevating exam table to lower the table to a comfortable height for the patient, which is usually the height of the knee joint. The patient stands on the unaffected leg (see inset picture) and places the affected knee over the Bucky. The position maintains a 70° relationship of the femur to the plane of the image receptor. Radiograph on right demonstrates resulting image.*

to adequately assess the region of the intercondyloid fossa without this projection. Consequently, the following 4 methods are described as variations that can be used in place of Holmblad's original position. Again note that an elevating examination table is recommended for adequate positioning.

Methods

Method 1: Partially Standing

This position does not require the patient to kneel on the exam table; instead, the patient is instructed to stand next to the x-ray table. The height of the table is adjusted to the height of the knee. Next, the affected knee is positioned over the Bucky. The leg supporting the patient should rest comfortably on the floor. The central ray (CR) is directed to the knee joint and the femur is flexed to form a 70° angle to the plane of the imaging receptor (IR). The source to image receptor distance (SID) is 44 inches. (See Fig. 4.) Alternatively, the IR can be placed on the table top if the patient complains of difficultly stretching to reach the Bucky.

Method 2: Partially Standing Using a Wheelchair

This position is similar to method 1 in that the table is lowered to the height of the knee and the affected knee is placed on the table top. (See Fig. 5.) The position is different in that it is performed at the end of the x-ray table and a wheelchair is used to maintain patient balance. It must be emphasized that the wheels must be in a locked position for safety. Though this position appears to be dangerous, the handles on the wheelchair provide comfortable support for the patient and the locked wheels prevent movement of the chair, thus providing good support. Sandbags also can be put in front of the wheels to reduce the chance of movement. However, do not attempt this position if there are any questions of stability or safety concerns for the patient. The IR can be placed on the table top or on a stool

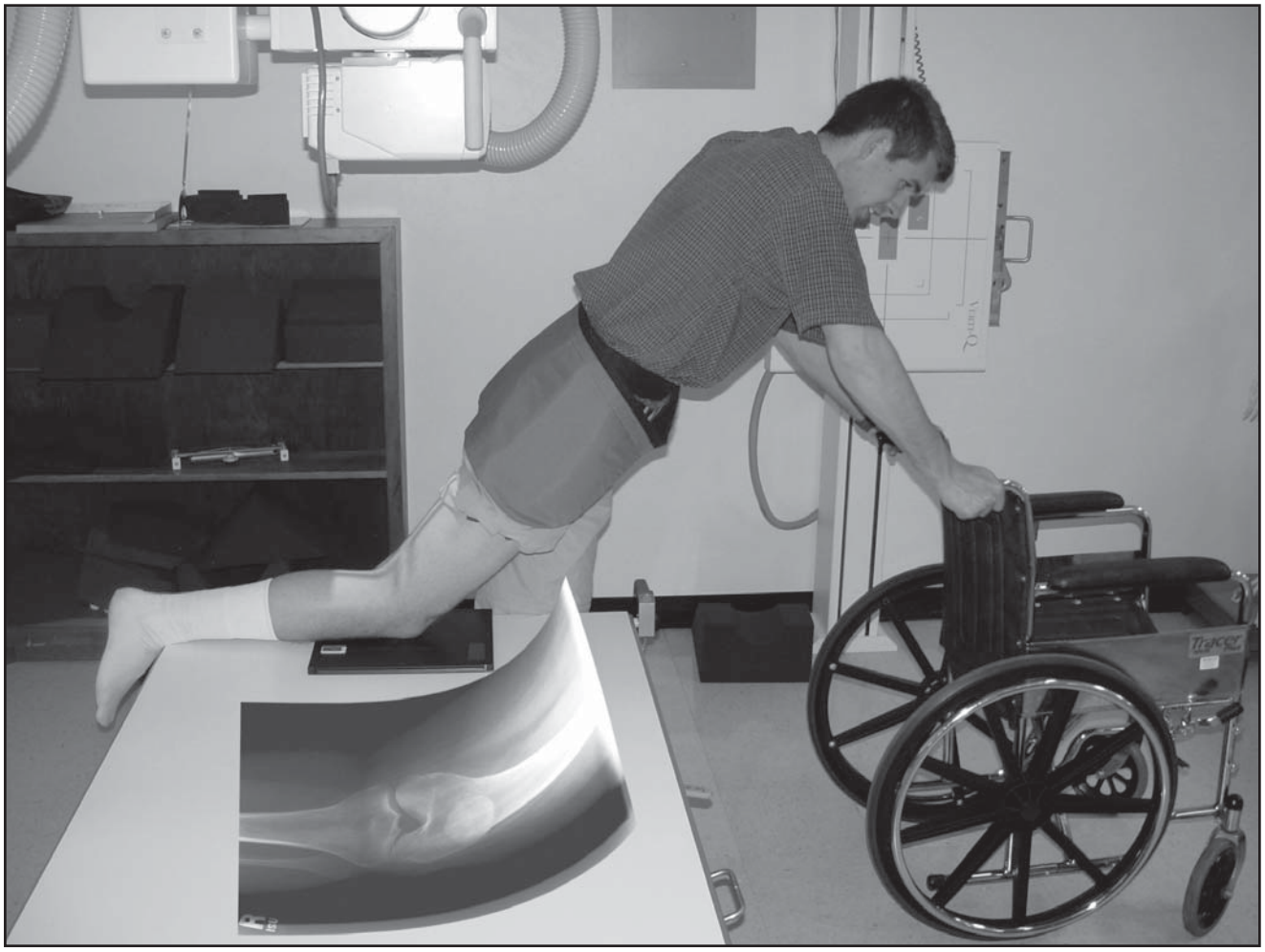

Fig. 5. *Partially standing using a wheelchair. This position uses an elevating exam table. The table is lowered to a comfortable height for the patient, which is usually the height of the knee joint. The patient stands on the unaffected leg and places the affected knee on the table top. A locked wheelchair and sandbags provide stability for the patient. The position maintains a 70° relationship of the femur to the plane of the image receptor. Do not perform this position if there are any concerns about patient safety.*

beneath the table. The CR is directed to the knee joint and the femur is flexed to form a 70° angle to the plane of the IR. The SID is 44 inches.

Method 3: Standing by Chair

This method uses a chair to provide support for the knee. Alternatively, a stool can be used as demonstrated by Ballinger, Frank[2] and Gilbert et al.[4] This position is similar to methods 1 and 2, with the exception that the IR is now placed on a chair. The patient then rests the affected knee on the IR. (See Fig. 6.) A step stool with rubber feet can be used by the patient for upper body support to help provide extra stability, if needed. The CR is directed to the knee joint and the femur is flexed to form a 70° angle to the plane of the IR. The SID is 44 inches.

Method 4: Standing by Wheelchair Utilizing the Upright Bucky

This method appears to be uncomfortable, but in practice is very easy and comfortable for the patient. The wheelchair is pushed against the upright Bucky and helps provide stabilization. Again, the affected knee is placed on top of the IR. The patient then straddles the wheelchair with the unaffected leg and leans on the

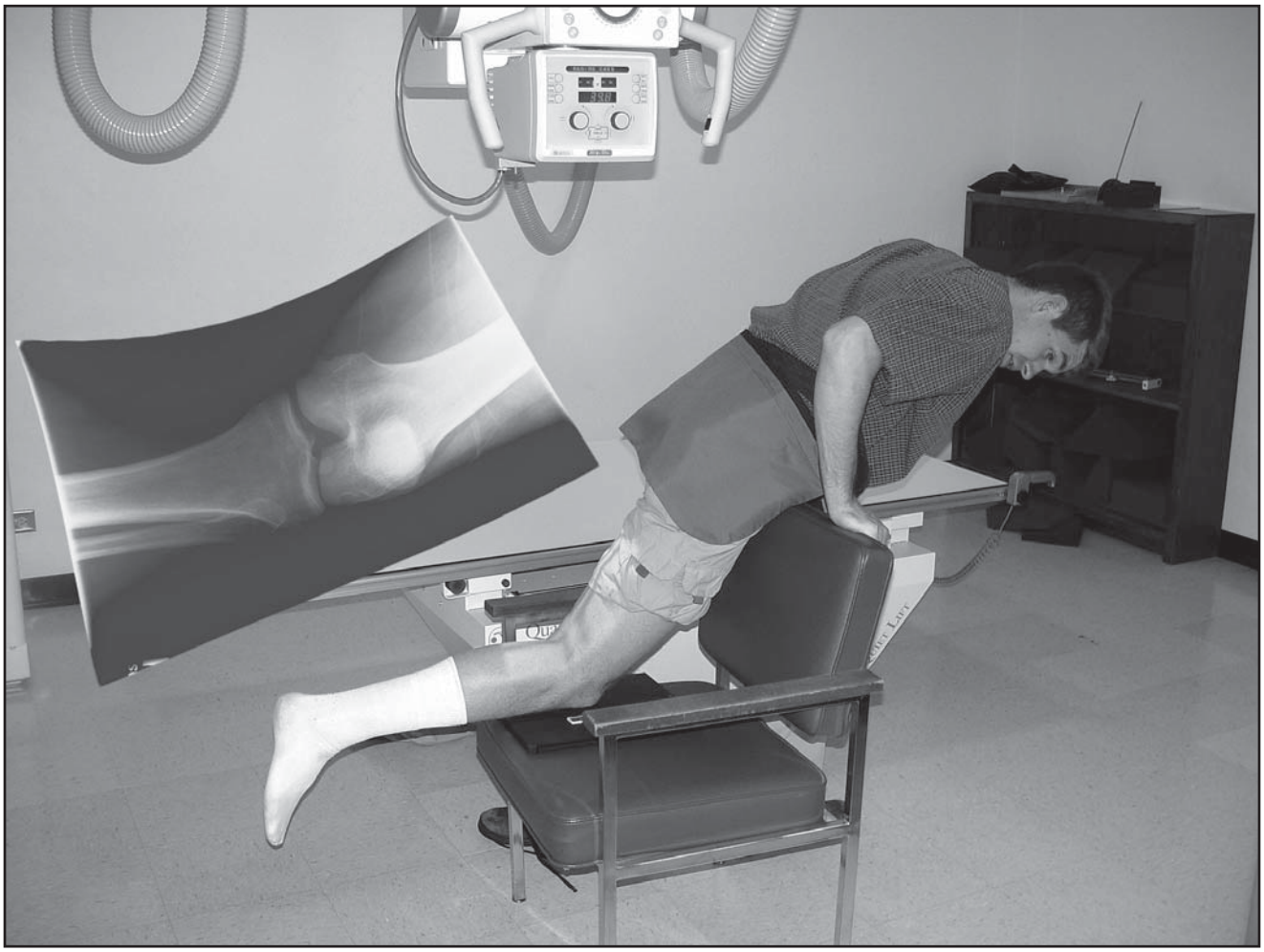

Fig. 6. *Partially standing by chair or stool. A chair is used to support the knee as the patient straddles the chair and stands on the unaffected leg. The position maintains a 70° relationship of the femur to the plane of the image receptor. If necessary, a locked wheelchair or step stool with rubber feet may be used to provide extra stability for the patient.*

upright Bucky for support. (See Fig. 7.) The upright Bucky locking mechanism should be engaged to prevent it from drifting. The CR is directed to the knee joint and the femur is flexed to form a 70° angle to the plane of the IR. The SID is 44 inches.

Discussion

Before the introduction of elevating tables, the Holmblad method was performed by having the patient assume a kneeling position on the exam table. This position is difficult because it requires both knees to be on the table while the patient assumes a semi push-up position to obtain the 70° relationship of the femur to the plane of the IR. This is easier said than done for most patients, even in the best of circumstances.

The introduction of elevating tables has made the position easier to maintain. Patients no longer are required to kneel on both knees but can be examined in a partially standing position. This is more comfortable and can be accomplished by raising or lowering the exam table to accommodate the height of the patient. These variations provide unconventional, somewhat easier, substitute positions for the Holmblad method. The disadvantages of these positions are that they require a cooperative patient with the ability to stand on at least 1 leg; therefore, most of these posi-

tions cannot be used during a trauma event.

Furthermore, 3 of these methods provide alternative positions that use a chair, stool or wheelchair. These positions are valuable, but must be used with caution. This means that wheelchairs should always be locked and sandbags should be used. If using the upright Bucky, the radiologic technologist should be sure the device also is locked so that it does not float up or down. The radiologic technologist always should evaluate the appropriateness of each of these positions and determine which position would be easiest for the patient.

In summary, the Holmblad method has been employed since 1937. It is still a valuable position and is performed routinely in many imaging centers. Granted, there are other ways such as the Béclere, Camp Coventry and Rosenberg[1,2,5] methods that have not been included in this discussion. All are valuable and are used to demonstrate the intercondylar fossa; however, the positions presented in this article are consistent in keeping the femur at a 70° angle to the plane of the IR and a perpendicular CR. Furthermore, a perpendicular CR reduces distortion, which is unavoidable when the tube is angled as required by the Camp Coventry and Béclere methods. The 4 positions demonstrated closely emulate the original method presented by Holmblad. Perhaps one of these variations will come to mind the next time you are asked to perform the intercondylar fossa, notch or tunnel projections. ◆

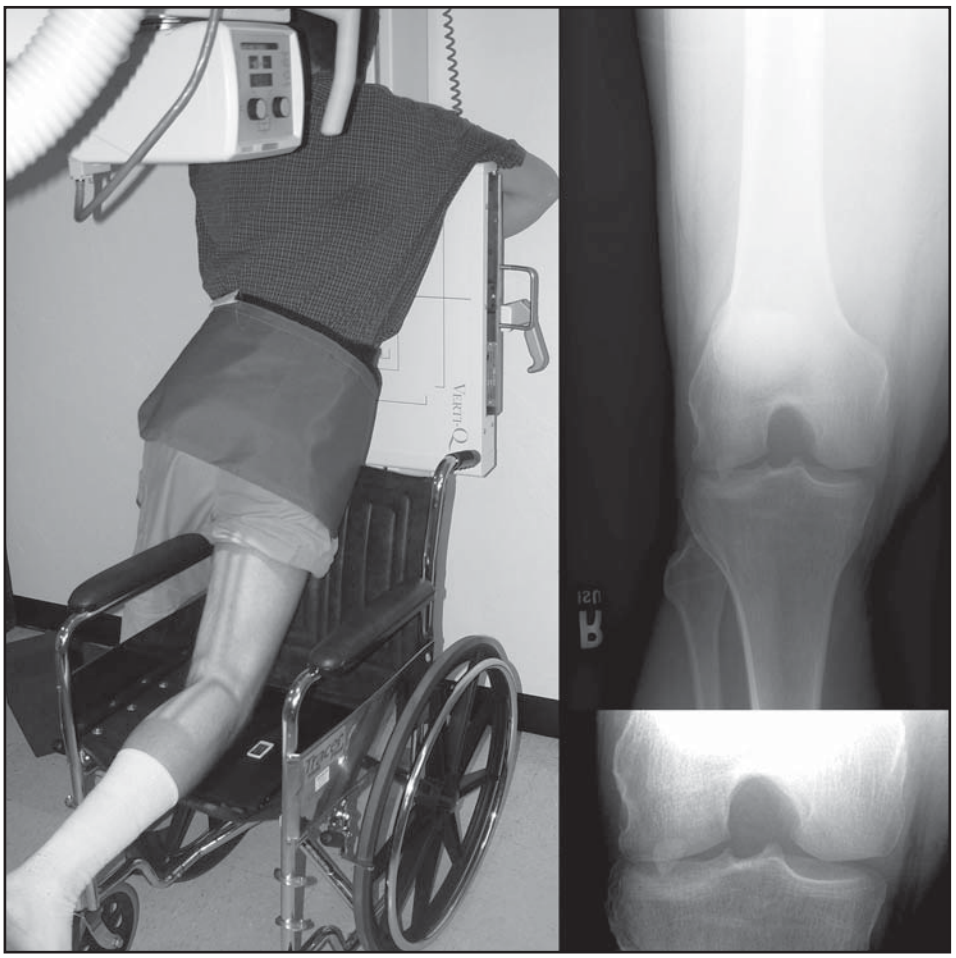

Fig. 7. *Partially standing by wheelchair using the upright Bucky. This method uses the upright Bucky to stabilize the wheelchair and to provide support for the patient. The upright Bucky must be locked. Likewise, a 70° relationship of the femur to the plane of the image receptor should be maintained. The radiographs demonstrate resultant images. Note the joint mouse in the lateral compartment.*

References

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