

Case Study: Antero-Posterior Projection of Pelvis Radiographic Examination Techniques in the Diagnosis of Hemiarthroplasty

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ARTICLE INFO

Article history:

DOI:

[10.30595/pshms.v2i.235](https://doi.org/10.30595/pshms.v2i.235)

Submitted:

December 6, 2021

Accepted:

January 21, 2022

Published:

January 26, 2022

Keywords:

Antero-posterior;
Hemiarthroplasty; Hip joints;
Pelvis; Radiography

ABSTRACT

Hemiarthroplasty is a surgical procedure to replace half of the hip joint with a prosthesis or artificial joint. The radiology procedure for the Hemiarthroplasty at Orthopaedic Hospital Purwokerto uses Antero-posterior projection of the pelvis. This projection is different from the routine projection, namely the Unilateral Antero-posterior Hip Projection. The purpose of this study is to determine the procedure for radiographic examination in cases of Hemiarthroplasty and to find out the reasons for using the Antero-posterior Pelvis projection to establish the patient's diagnosis. This type of research was qualitative with a case study approach. Data collection conducted in December 2020 at the Radiology Installation of the Orthopaedic Hospital Purwokerto, using the methods of observation, documentation, and interviews with radiographers and radiologists. Data analysis performed with primary data taken from one patient with Hemiarthroplasty. The patient has a history of fracture (broken bone) in the right side of the femoral neck before hemiarthroplasty surgery. The results showed that the proper projection for Hemiarthroplasty is the Antero-posterior Pelvis projection. The reasons were to see a comparison between the right and left hip joints and to find if there is a space or distance from the hip joints after the surgery procedure. Radiologists can get needed anatomical information about the pelvis by performing an Antero-posterior projection.

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1. INTRODUCTION

The development of radiology began with the discovery of X-rays by Wilhelm Conrad Roentgen in 1895. In line with the times, advances in radiation technology can be utilized for human needs, especially in the medical world. The use of this radiation includes radio diagnostic measures, radiotherapy, and nuclear medicine. Radiographic technique is a way to get an image of the object being photographed using long waves (x-rays) in order to establish a diagnosis. [2] In addition to history taking, radiographic examination also needs to be done as a supporting examination in diagnosing indications in the bones, one of which is the femur. Diagnostic radiology is to provide high quality diagnostic image information about anatomic detail. The radiographic examination is the main imaging method for evaluation and follow-up assessment of hip arthroplasty. Radiographic imaging prior to hemiarthroplasty can provide information about the patient's anatomical position.

The femur can be divided into three parts, namely the proximal end, the rod, and the distal end. The proximal end articulates with the acetabulum of the pelvis and the distal end with the patella and tibia. The proximal end consists of the femoral head, femoral neck, greater trochanter, trochanteric fossa, lesser trochanter, trochanter tertius, intertrochanteric line, and crista intertrochanteric. The head of the femur is a 2/3 spherical mass, directed medially, cranially, and forward. [10] The body of the femur is a long bone that

shrinks in the middle and it is cylindrical in shape. [8] At the distal end there are structures such as the medial condyle, lateral condyle, medial epicondyles, lateral epicondyles, patellar facies, intercondylar fossa, intercondylar line, adductor tubercle, popliteal fossa and sulcus. The neck of the femur is distal to the head of the femur and is the link between the head and the body of the femur.

One of the abnormalities or indications that often occur in bones is fracture. Fracture is a condition where there is a breakdown of continuity of bone tissue or cartilage either in part or in total that causes a broken bone to be in the form of direct trauma (injury and accident) and can be indirect trauma due to bone loss (osteoporosis). [6] One of the bones in the femur that often fractures is in the proximal femur. Femoral neck fracture is defined as a fracture of the proximal femur where the fracture line is more proximal to the base of the neck of the femur and distal to the head of the femur. A person's risk of experiencing a proximal femur fracture during their lifetime is 5.6% in men and 20% in women. The intensity of postoperative fracture pain in women is higher than that of men. [4] The risk of complications in patients with femoral neck fractures is higher than patients with osteoarthritis cases. Fractures of the neck of the femur are common, and account for about 20% of fractures requiring orthopaedic surgery. Some surgeons recommend hemiarthroplasty which is an arthroplasty procedure where this procedure involves replacing the femur of the hip joint with a prosthesis and leaving the acetabulum intact. The management of hemiarthroplasty in fracture cases aims to functionally restore the patient as before the injury. [3]

Some of the latest radiographic investigations are CT-Scan or MRI, but if only a fracture is suspected, then using conventional radiographs (x-rays) alone is sufficient to provide diagnostic information to the patient. In the overall diagnosis of hemiarthroplasty, radiographic examination of the hip and proximal femur with standard Antero-posterior (AP) projections of the unilateral hip was used. The projection is to show postoperative or follow-up examinations and to show the acetabulum, head, femoral neck and greater trochanter as well as to evaluate the condition and placement of orthopedic devices that have been installed. [5] Radiographic examination at the Radiology Installation of Orthopedic Hospital Purwokerto in patients with hemiarthroplasty cases using antero-posterior (AP) projection pelvic radiography.

Based on the fundamental difference between theory and reality in the hospital practice area, the authors would like to study further about the radiographic examination procedure in the hemiarthroplasty case at the Radiology Installation of Orthopedic Hospital Purwokerto and the reasons for using the Antero-Posterior (AP) projection of the pelvis.

2. RESEARCH METHOD

This type of analysis uses a qualitative approach with a hemiarthroplasty case study. This data collection was carried out at the Radiology Installation of Orthopedic Hospital Purwokerto. Data collection in December 2020. The method used consisted of observation, documentation of the request letter for radiographic photos and the results of radiographic readings, and interviews with radiographers and radiologists.

Data processing and analysis is done by interactive model analysis, which is done by collecting data, reducing data, presenting data and drawing conclusions. The first stage of this research includes an exploration of the theory of hemiarthroplasty case examination techniques. Phase two involves reviewing the literature with facts about conditions occurring in the workplace/hospital.

In November-December 2020, from a population of 14 hemiarthroplasty patients, a sample of one hemiarthroplasty patient was taken with an Antero-posterior Pelvis photo request. The subjects of this study were one patient, two radiographers, one radiologist and one dispatching doctor at the Radiology Installation of Orthopedic Hospital Purwokerto.

3. RESULT AND DISCUSSIONS

The female patient named Mrs. B (60 years old) came to the Radiology Installation of Orthopedic Hospital Purwokerto and carried out a radiology examination on December 4th, 2020 by bringing a request letter for radiology photos from the sending doctor. Photo request: AP Pelvis; Diagnosis/Clinical: *Post Austin Moore prosthesis (AMP)/Hemiarthroplasty*. The patient had a history of fracture (broken bone) on the right side of the neck of the femur which had been done radiographically before hemiarthroplasty surgery.

Table 1. Preparation of Tools and Materials

Tools Name	Model	Serial Number
X-ray Machine	Allengers 525 FC type E7239	1J0074
<i>Image Receiver</i>	35 x 43 cm	-
<i>Processing Film</i>	<i>Computer Radiography (CR) Agfa 10-X</i>	-

Based on observations, the radiographic examination technique for hemiarthroplasty cases at the Radiology Installation of Orthopedic Hospital Purwokerto uses the Antero-posterior (AP) projection of the pelvis. The radiographic examination does not require special preparation, but the patient is asked to remove objects that can interfere with the radiographic image or artifacts. Then, the patient is given an explanation of the examination to be carried out. In detail, the pelvis Antero-posterior (AP) projection can be described as follows:

Table 2. The Pelvis AP Projection

Indicator	Description
Patient Position	The patient is positioned supine on the examination table, both hands are beside the body, a pillow is placed to rest the patient's head.
Object Position	Set the mid sagittal plane (MSP) in the middle of the table, if possible, rotate the legs inward as much as possible.
Central Point (CP)	5 cm below the iliac crest
Central Ray (CR)	Vertical perpendicular to the cassette
Focus-Film Distance (FFD)	102 cm
Exposure Factor	72 kV, 30 mAs



Figure 1. The results of the AP pelvis projection radiography Mrs. B

Based on the reading of the patient's photo, Mrs. B on radiographic examination of the pelvic AP projection with a hemiarthroplasty case by a radiology specialist, the results of the examination are no visible dislocation, dextra/right AMP/Austin Moore Prosthesis installed in a good position, and pelvic girdle, sacrum, coccyx, femoral heads and neck, and greater trochanters are visible.

Film and image processing performed at the Radiology Installation using Computer Radiography (CR). The following are the differences in the Unilateral Hip AP Projection radiograph found in [1] and the Pelvis AP Projection found at the Purwokerto Orthopedic Hospital. Unilateral Hip Projection radiograph criteria are shown 1/3 of the proximal femur along with acetabulum, greater trochanter, lesser trochanter, and femoral head fully visible without foreshortening, hemiarthroplasty visible in its entirety and shown partial view of the pubis, ischium, and ilium, and no movement is indicated by the greater trochanter and neck of the femur looks sharp.



Figure 2. Unilateral hip AP radiograph



Figure 3. Pelvis AP Radiograph

3.1 The preparations between radiographic examination in hemiarthroplasty cases at the Radiology Installation of Orthopedic Hospital Purwokerto and at the theory which is in Bontrager 2018

Patient preparation for radiographic examination in hemiarthroplasty cases at the Radiology Installation of Orthopedic Hospital Purwokerto is in accordance with the theory of [1] so that no special preparation is required, the patient is asked to remove objects such as metal, for example, pants zippers that can cause opaque shadows from the pelvic area and femur. The instructions regarding the patient's position and the examination procedure must be explained. Therefore, the patient knows the course of the examination and will be more cooperative during the examination. Postoperative fracture pain can cause discomfort. [9] Patients who experience fractures and require hemiarthroplasty must have limited movement, so that if the patient is positioned for a long time, it will affect radiological examination services. The equipment that needs to be prepared in the radiographic examination of hemiarthroplasty cases at the Radiology Installation of Orthopedic Hospital Purwokerto is an x-ray unit and an imaging plate measuring 35 x 43 cm placed transversely.

The preparation of these tools and materials is sufficient because these tools have helped the inspection process. Preparation of tools and materials is quite simple because this examination does not use contrast media. However, it is better to use the Pb/Lead R/L (Right/Left) marker when conducting the examination so that the processing in Computer Radiography (CR) is more helpful in showing the side being photographed. The placement of markers is very important in the radiographic examination procedure. This is a marker of the object being examined and prevents the radiographer from making mistakes in making radiographs. The imaging plate measuring 35 x 43 cm is placed transversely because the object being photographed is more directed towards the pelvic area and the two femoral necks (bilateral hip joint) both those who have had hemiarthroplasty and normal ones.

3.2 The differences between radiographic examination in hemiarthroplasty cases at the Radiology Installation of Orthopedic Hospital Purwokerto and at the theory which is in Bontrager 2018

In theory, according to [5], examination of the femoral neck in hemiarthroplasty cases uses the AP Unilateral hip projection. In this projection, the imaging plate used is smaller than the pelvic AP projection used in the Radiology Installation of Orthopedic Hospital Purwokerto. In the Unilateral AP projection, the hip uses an imaging plate measuring 24 x 30 cm longitudinal because the x-ray photo only takes one side of the hip joint. It will also produce a radiographic image that is more inclined to the femur so that the entire hemiarthroplasty can be seen more clearly than the AP Pelvis projection. In terms of object position, the radiographic examination of the hemiarthroplasty case at the Radiology Installation of Orthopedic Hospital Purwokerto only rotated the lower limbs as much as possible. Judging from [5], the degree of rotation of the lower limbs is very important to produce an optimal image in the range of 15-20 degrees. The radiographer may place an additional sandbag to maintain the foot position.

The reason for using the pelvis AP projection in the case of hemiarthroplasty at the Radiology Installation of Orthopedic Hospital Purwokerto, is to see a comparison between the right femoral neck and the left femoral neck postoperatively. The purpose of this comparison is to see if there is any space or distance in the femoral neck after hemiarthroplasty. To find out, this is done by comparing the post arthroplasty femoral neck with the normal femoral neck. By knowing whether or not there is a distance in the femoral neck after surgery, it will determine the physiotherapy action that needs to be done. These projections are different from those in theory. Based on [5], the purpose of using the Unilateral Hip AP projection is to reveal the entire hip joint and hemiarthroplasty, namely the prosthesis from the head of the femur to the neck of the femur. Differences in these projections can cause radiographs that differ from the standard that should be used to support fracture diagnosis. The resulting radiograph results were less

satisfactory because the evaluation criteria for the AP Pelvis projection are more about the sides of the pelvis, the 5th lumbar vertebra, the sacrum, the head and neck of the femur and greater trochanter. A point on the femur, usually the lesser trochanter, is then used as the femoral reference line. The line is drawn from the femoral to the pelvic reference line and the two sides are measured and compared. [7] Higher placement of the prosthesis results in less effective muscle traversing of the hip joint, which can increase the risk of dislocation. On the AP Pelvis projection, the position of the lesser trochanter is not clearly visible. Optimal exposure should show good bony detail in addition to soft tissue shadowing of the pelvis. In this case, the AP projection of the pelvis shows more pelvic bone than the femoral neck, which is an indication point in the case of hemiarthroplasty.

In the Unilateral Hip AP projection, the Central Ray (CR) is perpendicular to the cassette and the Central Point (CP) is 2.5 cm-5 cm medial and 8-10 cm distal to the ASIS (Anterior Superior Iliac Spine). [5] Compared with the CP on the AP Pelvis, which is 5 cm below the iliac crest, on the Unilateral hip AP projection the hip is more able to reveal the entire proximal femur from the acetabulum, femoral head, femoral neck to the greater trochanter. On the Unilateral AP projection, the proximal third of the hip is visualized and the acetabulum adjacent to the pubis, ischium and ilium. In addition, orthopedic equipment, including one example of hemiarthroplasty, is clearly visible in the image. The position of the greater trochanter and the head and neck of the femoral head were seen throughout without any constriction. Optimal exposure factor settings can visualize the edges of the femoral and *acetabular* clearly and the *trabecular* of the *greater trochanter* and the femoral neck region are sharp. However, on the Unilateral AP projection, the hip cannot compare between the operated and normal femoral neck because it is unilateral or single.

3.3 The thing that needs to be considered in patient safety

The thing that needs to be considered in patient safety is the use of smaller cassettes, automatically the use of collimation/radiation field area is smaller than the Pelvis AP projection, so that the radiation dose received by the patient can be minimized. Other things that can be done apart from paying attention to the accuracy of the examination, it is also necessary to the principle of radiation protection to patients, officers and the general public who are around the examination room. Collimation sufficiently by reducing the area of the irradiation field, using the right exposure factor, there is no repetition of photos due to errors, exposure time is as short as possible, and use an apron on the patient.

While protection for officers can be done by taking cover behind a protective screen when doing exposure, officers keep a distance from radiation sources during inspection. officers use a personal radiation measuring device (film badge) while on duty which is sent to the Health Facility Security Agency every month to monitor the radiation dose received by officers. From some evidence/results regarding differences in the use of AP Unilateral Hip and AP Pelvis projections, it can be considered because using AP Unilateral Hip projections can speed up radiological examination services and increase patient comfort when positioning objects, as well as increase patient safety by minimizing radiation doses but radiographic images is also optimal to establishes the diagnosis.

4 CONCLUSION

Radiographic examination techniques in hemiarthroplasty cases at the Radiology Installation of Orthopedic Hospital Purwokerto using the AP Pelvis projection. The reason for using AP Pelvis radiography in hemiarthroplasty cases is to compare the normal hip joint with the operated hip joint. The purpose of this comparison is to see if there is any space or distance in the femoral neck after hemiarthroplasty. The researcher suggests that it is preferable to use the Unilateral AP hip projection in the case of hemiarthroplasty to better reveal the overall anatomy of the proximal femur and hemiarthroplasty. If a comparison is required which is comparing the postoperative femur with a normal femoral neck, a bilateral hip AP projection can be performed, showing the right and left hip joints by lowering the cassette position.

Acknowledgements

Thank you to Allah SWT, both parents and all comrades in arms who have helped from beginning to end.

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