



Genu Scanogram Examination Procedure In Cases Osteoarthritis at the Radiology Installation of K.R.M.T Wongsonegoro Hospital, Semarang City

Indrawan Nurhadi¹, Retno Wati²

^{1,2}Radiology Study Program Diploma Three Program Faculty Of Health Sciences, University Of 'Aisyiyah Yogyakarta

Email: ¹2314010018@takumi.ac.id, ²diwana.dfa@takumi.ac.id

Article Info

Article history:

Received Jun 25, 2026

Revised Jul 10, 2026

Accepted Aug 28, 2026

Keywords:

Genu Scanogram,
Osteoarthritis, Deformity, AP
Long Leg, Mechanical Axis

ABSTRACT

Abstract: Background: Genu examination is a radiographic examination to view the condition of the genu or knee. In previous studies, genu examination in osteoarthritis patients applied bilateral weightbearing anteroposterior (AP) projection. However, at the Radiology Installation of K.R.M.T Wongsonegoro Hospital, Semarang City, the same case uses the genu scanogram examination technique with long leg AP projection. The purpose of this study was to determine the examination procedure and the reason for using the long leg AP projection in clinical osteoarthritis. Methods: The study employed a qualitative study with a case study approach conducted at the Radiology Installation of RSD (Regional Hospital) K.R.M.T Wongsonegoro, Semarang City, from September 2025 to June 2026. The research subjects consisted of three radiographers and one radiology specialist, with the research object being the genu scanogram examination procedure for clinical osteoarthritis. Data collection was carried out through observation, interviews, and documentation. Data were analyzed narratively through transcription, reduction, and data categorization, compared with theory, and then conclusions were drawn. Results: Genu scanogram examination in osteoarthritis patients required no special preparation other than removing metal objects that could interfere with the radiographic results. The equipment included an X-ray unit, detector, computer, wall stand, radiographic ruler, and foam as a patient standing platform. The examination was performed using AP long leg projection with three exposures covering the area from the femur to the ankle, with the beam direction perpendicular to the patient. The use of AP long leg projection was chosen because it can optimally display the condition of the genu, including joint space, mechanical axis, and alignment of the lower extremities, thereby supporting diagnosis and treatment planning for osteoarthritis. Conclusion: Genu scanogram examination with long leg AP projection (three exposures from femur to ankle, perpendicular beam direction) in osteoarthritis patients requires no special preparation other than removing metal objects, and is able to optimally display the joint space, mechanical axis, and alignment of the lower extremities, thereby supporting the diagnosis and treatment planning of osteoarthritis. The use of additional projections such as lateral may be considered to complement anatomical information and enhance patient information

This is an open access article under the [CC BY-SA](#) license.



Corresponding Author:

Indrawan Nurhadi

Radiology Study Program Diploma Three Program Faculty Of Health Sciences, University Of 'Aisyiyah Yogyakarta

Email: 2314010018@takumi.ac.id



1. INTRODUCTION

The *genu* or knee joint is the largest joint in the human body, this knee joint is a combination of the condylar joint located between the condyle and tibia and a saddle joint between the *pattela* and *femur*, the movement of this knee joint is flexion and extension (Kimantoro, 2019). The bones that make up this knee joint are: *tibiafemoral joint*, *patellafemoral joint* and *tibiafibular joint*. This joint is also formed from several bones, namely: 2 *femurs*, *tibia bones*, *fibula bones* and *pattela bones* (Maulana, in Anwar, 2022).

Abnormalities that can occur in the *genus* are *fractures*, dislocations and *osteroarthritis*. *Osteoarthritis* (OA) is a degenerative disease of the joints. This disease is characterized by damage to *cartilage* in the knee joint. *Osteoarthritis* is also often called *degenerative joint disease* (DJD), which is inflammation that occurs in the joints which is characterized by degenerative cartilage and enlargement (*hyperthrophic*) of bone structure (Lampignano, 2018). OA patients usually complain of pain during activities or if there is a load on the affected joint, in a heavier degree pain can be felt continuously, interfering with the patient's mobility. *Osteoarthritis* (OA) is one of the musculoskeletal diseases whose prevalence continues to increase in Indonesia. Based on data from the *Global Burden of Disease (GBD) Study 2019*, it is estimated that there are around 9.66 million *osteoarthritis* sufferers in Indonesia in 2019. Of these, around 7.78 million cases are *genu osteoarthritis*, thus showing that the knee joint is the most frequently affected location for OA. In addition, the prevalence of OA in Indonesia continues to increase from year to year and is one of the main causes of disability in the elderly population. Therefore, action is needed to overcome this problem as stated in the holy verse of the Qur'an surah Ash-Shu'ara verse 80 which means:

"And when I am sick, He is the One who heals me." (QS. Ash-Shu'ara verse 80)

In this verse, it is emphasized that Allah SWT is the main source of healing, but the healing comes through the efforts (efforts) that He has created. For this reason, it is the obligation of Muslims to seek treatment through modern science such as conducting radiological examinations to detect a disease. The other is the *genu radiography examination*.

Genu radiography examination is an imaging procedure with x-rays to image the knee joint and the surrounding bone structure (Prayoga & Sulistyowati, 2024). According to Lampignano (2018) there is no special preparation for the *genu* radiography examination. Only remove metal objects around the object to be examined. According to Long (2016) The preparation of tools and materials for *radiography examination in osteoarthritis* patients includes an x-ray plane, a 24 x 30 cm imaging plate, markers, gonad shields, and printers.

The *genous radiography examination procedure* with *osteoarthritis* clinically was carried out using several projections, namely *anterior posterior (AP) Weight Bearing*, *Oblique*, *Lateral*, and *mediolateral* with CR incision of 5-7 degrees towards the *cephalad* (Lampignano, 2018). Meanwhile, according to Clark (2016), the radiographic examination used to see abnormalities in the *genu* is *mediolateral projection* and *weight-bearing AP*. According to Kamila (2024), the *gene radiography examination procedure in osteoarthritis* cases at the Radiology Installation of Sebelas Maret University Hospital uses *Posterior Anterior (PA) Weight Bearing projection* with an infusion of 15 degrees towards the *caudad* and *lateral*.

Meanwhile, while undergoing field work practice at the Radiology Installation of K.R.M.T Wongsonegoro Hospital, Semarang City, the author found a *genu examination* in patients with clinical *osteoarthritis* which was carried out using a long leg Anterior Posterior (AP) projection *genu scanogram*. This technique differs from some of the previous literature and studies that generally recommend the use of AP *weight bearing*, *oblique* and *lateral* projections in the evaluation of *osteoarthritis disorders* of the knee joint. The difference in the application of these techniques shows that there is a variation in the practice of radiography examination in the field, especially related to the use of long leg AP projection which focuses more on assessing the overall alignment of the lower extremities. Although some studies have addressed *genu-radiography examination in osteoarthritis cases*, studies that specifically address the role and reasons for using long leg AP projections as part of *genu scanogram* examinations are limited. This study aims to find out the procedure for *genu scanogram* examination in *osteoarthritis* patients and the reason for the use of Anterior Posterior (AP) long leg projection in the *genu scanogram examination* at the Radiology Installation of K.R.M.T Wongsonegoro Hospital, Semarang City.

Based on this, the author wants to study further related to *gene examination* in patients with clinical *osteoarthritis* with long leg AP projection at the Radiology Installation of K.R.M.T Wongsonegoro Hospital, Semarang City with the title "Genu Scanogram Examination Procedure in *Osteoarthritis Cases* at the Radiology Installation of K.R.M.T Wongsonegoro Hospital, Semarang City".

Literature Review

1. Gene anatomists

The *genu* or knee joint is the largest joint in the human body, this knee joint is a combination of the condylar joint located between the condyle of the *femur* and *tibia* and a saddle joint between the *pattela* and *femur*, the movement of this knee joint is flexion and extension (Kirmantoro, 2019). The *genu* or knee joint is the link between bones so that it can be moved. The bones that make up the *genu* are:

a. Femur Bone

The *femur* or thigh bone is the longest bone of the body. This bone is a joint with the acetabulum of the pelvic joint and this bone is a pipe bone (Irianto, 2017).

b. Pattela Bones

The *pattela* is a small triangular bone located between the femur and the shin bone, about 5cm. The function of the *pattela* is as follows:

- 1) Shaping and strengthening joints
- 2) Helps the knee joint bend and move
- 3) Protects the joint from injury
- 4) connecting the muscles of the femur and the shin muscles

c. Cruris Bone (*Tibia and Fibula*)

The *tibia bone* is the main skeleton of the lower limb and is located in the medial *fibula*. The *tibia* bone is a pipe bone that has two ends, the upper end of the medial condilus and the *lateral* condilus. This condilus is the top and most peripheral part of the bone while the lower end is a bone slightly wider to the medial side of the towering medial called the medial maleolus or maleolus *tibia* (Pearce, 2016). The *fibula* or calf bone is the *lateral bone of tibiae* or the leg bone, this *fibula* bone has two ends, namely: (1) the upper end is head-shaped and jointed with the back of the *tibiae*, but it is not included in the form of the knee joint. (2) the lower end of this bone is more elongated to form the *maleolus lateralis* or maleolus *fibula* (Pearce, 2016).

d. Genu

The *genu* or knee joint is the largest joint in the human body, this knee joint is a combination of the condylar joint located between the condyle of the *femur* and *tibia* and a saddle joint between the *pattela* and *femur*, the movement of this knee joint is flexion and extension (Kimantoro, 2019). The *genu* or knee joint is a link between bones so that it can be moved. A picture of the anatomy of *genu* can be seen in the following image:

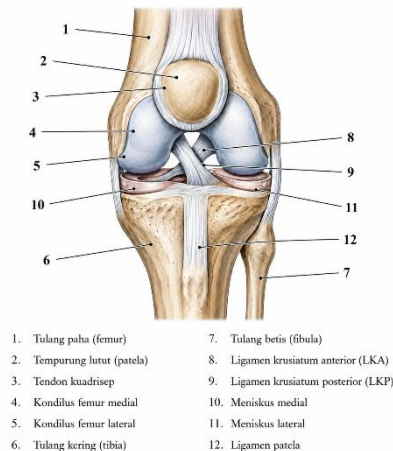


Figure 1. Anatomy of *genu* (Netter, 2022)

2. Osteoarthritis

Osteoarthritis is a degenerative disease of the joints. This disease is characterized by *cartilage damage* to the knee joint, *osteoarthritis* is also often called *degenerative Joint diseases* (DJD), which is inflammation that occurs in the joints characterized by degenerative cartilage and *hypertrophic* bone structure (Lampignano 2018). The prevalence of OA in the world is included in the high category ranging from 2.3% to 11.3%, in addition to that OA is a musculoskeletal disease that often occurs, which is in the 12th order among all existing diseases. It can be observed that the prevalence of OA at the age of > 60 years is estimated at 10-15% with an incidence rate of 18.0% in women and 9.6% in men, high compared to men (Ireneu et al. 2017). The prevalence of *osteoarthritis* is 55 million people (24.7%). According to basic health research (RISKESDAS), the prevalence of *osteoarthritis* by age is 5% at the age of 61 years (Thahira, 2024).

Generally, this disease has a slow progressive nature, generally in old age, although age is not one of the risk factors. Some references state that the incidence rate of OA increases with age, especially at the age of > 50 years, this is related



to the degeneration of cartilage (Imayati, 2011). Other factors that are suspected to trigger *osteoarthritis* are gender, obesity, and *overuse* factors (Arisa, 2012). This disease is characterized by the presence of cartilage abrasion of the joints and the formation of new irregular bones on the surface of the joints. Pain is the main symptom of osteoarthritis. Pain occurs after doing activities with the use of joints and pain is accompanied by rest (Izzah, 2025).

Grades in *osteoarthritis* are generally assessed using the Kellgren-Lawrence (K-L) classification based on the radiographic picture. This system divides *osteoarthritis* into five levels, namely grade 0 to grade 4. *Grade 0* indicates the absence of radiological signs of *osteoarthritis*. *Grade 1* is characterized by the possibility of the appearance of very small osteophytes without a clear narrowing of the joint gap. In *grade 2*, osteophytes appear to be more pronounced with the possibility of narrowing of the joint gap, so it is the minimum limit to establish a radiological diagnosis of osteoarthritis. *Grade 3* is characterized by larger osteophytes, a pronounced narrowing of the joint gap, increased subchondral bone sclerosis, and the possibility of developing deformities on the bone surface. Meanwhile, grade 4 is the most severe degree, characterized by a very significant narrowing of the joint gap, large osteophytes, severe subchondral sclerosis, and pronounced bone deformities due to progressive joint damage. This classification is widely used as a reference in determining the severity of *osteoarthritis*, helps evaluate the progression of the disease, and becomes a basis for the selection of appropriate management (Kellgren & Lawrence, 1957; Altman et al., 1987).



Figure 2. Clinical pathology of OA (Jewel et al., 2024)

3. Knee Joint Examination Procedure

a. Inspection indications:

1) Fracture

Fracture is the loss of bone continence, this condition will interfere with the function of passive body mobility tools as a body support and will cause disability (Kapel, 2019).

2) Dislocation

Dislocation is an injury to the joint that occurs when the articular surface of the bone loses normal anatomical connection due to a shift of the bone from its proper position. One of the dislocations that can occur in the lower extremities is knee dislocation, which is the loss of compatibility between the femur and tibia which is generally caused by high-energy trauma and can be accompanied by ligaments, nerves, and blood vessel injuries (Mohseni et al., 2024).

3) *Osteoarthritis*

Osteoarthritis is a degenerative disease of the joints. This disease is characterized by *cartilage damage* in the knee joint. *Osteoarthritis* is also often called *degenerative joint disease* (DJD), which is inflammation that occurs in the joints which is characterized by degenerative cartilage and *hyperthropic* of the bone structure (Lampignano 2018).

b. Patient preparation

According to Lampignano (2018), there is no special preparation for genu radiography examination, only releasing metal objects around the object to be examined.

c. Preparation of tools and materials:

According to Lampignano and Kendrick (2018), the following are the preparation of genu radiography examination tools and materials :

1) X-ray plane

2) Q checkpoint

3) Cassettes size 24 x 30 cm

- 4) Marker
- 5) Apron
- 6) Fixation tools
- d. Examination Techniques

According to Lampignano and Kendrick (2018), radiography examination can be done with several projections, namely:

- 1) Posterior anterior projection
 - a) This projection aims to see abnormalities or diseases in the anterior *genus*.
 - b) Patient position: the patient is positioned in the *supine / erect position*, the patient's leg must be straightened
 - c) Object position; position the patient's foot true *anterior posterior* (AP), place the tape under the patient's knee

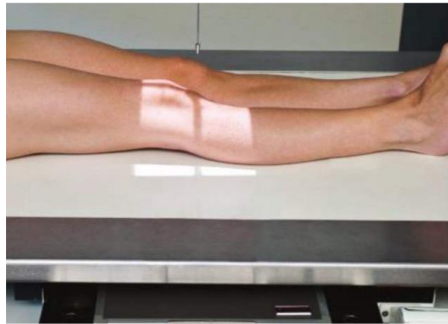


Figure 3. Patient position AP Projection (Lampignano, 2018)

- d) Titik bidik (*central point*) : 1,2 cm distal apex patella
- e) Direction of light (*central ray*) : Perpendicular
- f) FFD (*focus film distance*): 100 cm
- g) Exposure factors; 60-75 kv
- h) Image Result :



Figure 4 Radiograph Results of AP projection knee joint (Lampignano, 2018)

- i) Criterion radiographer:

The radiograph criteria on the AP projection showed distal *femur*, proximal *tibia* and *fibula*, *open femorotibial joint gap*, and no rotation.
- 2) Lateral projection
 - a) Projection aims to see any abnormalities in the knee joint/ *genu* from the side
 - b) Patient position: position the patient in a *supine / erect state*
 - c) Object position: adjust the rotation of the body and legs to the true *lateral knees*, adjust the knees flexion from 20 degrees to 30 degrees, adjust the knees in the middle of the tape.

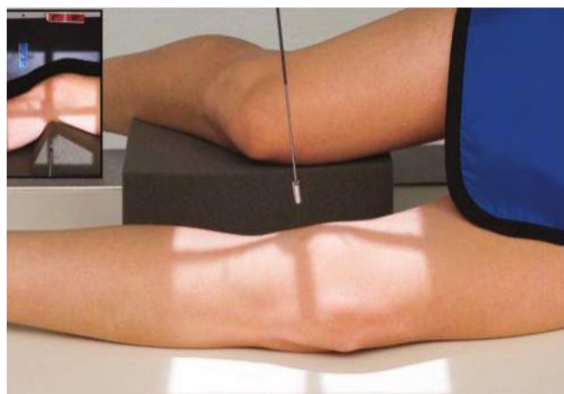


Figure 5. Lateral Projection Patient Position (Lampignano, 2018)

- d) Aiming point (*central point*) : 1.2 cm distal apex patella
- e) Direction of light (*central ray*) : perpendicular
- f) FFD (*focus film distance*): 100 cm
- g) Exposition factor: 60-75 sq.
- h) Image Result :



Figure 6. Radiography Results of Lateral Projection of Knee Joint (Bontrager, 2018)

- i) Criterion radiographer:
The Radiography Criterion for *Lateral Projection* is to show the knee and *patella* joints clearly with the superposition of the femur condyle which shows the *true lateral position*.
- 3) Projection *Weight Bearing*
 - a) The projection aims to assess *joint space*, *alignment*, and knee joint abnormalities to withstand the load (*weight bearing*).
 - b) Patient position: position the patient in an *erect* state facing *bucky*, the weight resting on two legs evenly.
 - c) Object position: set both knees *true AP*, legs straight forward, making sure *the patella* is facing forward. Knee full or light extension 5-10 degrees as per clinical request. Place knee in the middle of the tape.



Figure 7. Position of Anterior Posterior (AP) Weight Bearing Projection Patient (Lampignano, 2018)

- d) Central point : directed to the middle of the knee joint, 1-2 cm distal *apex pattela*
- e) Beam direction (*central ray*): perpendicular to the cassette
- f) FFD (*focus film distance*): 100 cm
- g) Exposition factor: 60-75 sq.
- h) Image Result :

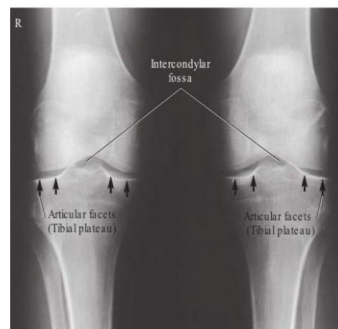


Figure 8. Results of Posterior Anterior Projection (AP) Weight Bearing (Lampignano, 2018)

- i) Criterion radiographer:
The Radiograph Criterion on the AP *weight bearing* projection is to show both knee joints in a standing position with a physiological load distribution, so that joint gap narrowing, *osteophytes*, and varus or valgus deformities can be optimally evaluated
- 4) Oblique Projection
 - a) The projection aims to see the structure of the femur condyle , *tibia plateu*, and medial or lateral knee joint gaps and detect fractures or joint abnormalities that are not visible in AP projections.
 - b) Patient Position: position the patient in a *supine* state on the examination table.
 - c) Object Position: set the knee full extension, rotate the legs and knees by 45 degrees internally (for medial) or 45 degrees externally (for internal obliques). Make sure the knee is in the middle of the tape.



Figure 9 and Figure 10. Patient Position of bilateral and internal Oblique Projection (Lampignano, 2018)

- d) Central point: directed to the middle of the knee joint, 1-2 cm distal *apex pattela*
- e) Beam direction (*central ray*): perpendicular to the tape.



- f) FFD (*focus film distance*): 100 cm
- g) Exposure factors: 60-75 kv
- h) Image Result :



Figures 11 and 12. Results of Bilateral and Internal Oblique Projection Radiography (Lampignano, 2018)

- i) Criterion radiographer:
Radiography criteria showing both knee joints in a load-bearing position with medial and lateral *femorotibial* joint gaps clearly visible for the evaluation of joint gap narrowing

METHOD

Qualitative research with a case study approach. This study studied *Genu Scanogram Examination Techniques* in Osteoarthritis Cases. The research location was conducted at the Radiology Installation of K.R.M.T Wongsonegoro Hospital, Semarang City, with the research implementation time lasting from September 2025 to June 2026. The research subjects consisted of three radiographers and one radiology specialist. The object of the study is the procedure for examining *the clinical genu scanogram of osteoarthritis* at the Radiology Installation of K.R.M.T Wongsonegoro Hospital, Semarang City. The research data used are: primary data are data that have been collected directly by the researcher from informants. Primary data in this study includes information about the procedure for examining *the genu scanogram* in patients with clinical *osteoarthritis* at the Radiology Installation of K.R.M.T Wongsonegoro Hospital, Semarang City, such as conducting direct interviews with radiographers and specialists. Secondary data is data that has been obtained from other sources, namely from journals, textbooks, documentation, and hospital records.

In this study, the data collection methods include:

1. Observations

Observation was carried out by directly observing the implementation of *the genu scanogram* examination in patients with clinical *osteoarthritis* at the Radiology Installation of K.R.M.T. Wongsonegoro Hospital, Semarang City. The researcher followed the course of the examination starting from the preparation of the patient, the preparation of the tool, the examination process, until the examination was completed. During the observation, the researcher observed every stage of the genu scanogram examination, starting from patient preparation, tool preparation, determination of patient positioning, to the implementation of irradiation and evaluation of radiography results.

2. Documentation

The documentation involves the medical records of patients who have undergone *genu scanogram examination techniques* in patients with clinical *osteoarthritis* at the Radiology Installation of K.R.M.T Wongsonegoro Hospital, Semarang City. The data to be documented includes information about the diagnosis, results of radiological examinations, usage records and other relevant information. Camera

The camera is used to take relevant images regarding *genu scanogram* examination techniques in patients with clinical *osteoarthritis*.

In this study, we used a variety of instruments to collect data, such as:

1. Observation Guidelines

This observation guideline is used to observe the implementation of *genu scanogram* examination in *osteoarthritis patients* at the Radiology Installation of K.R.M.T Wongsonegoro Hospital, Semarang City. Starting from patient preparation, preparation of tools and materials, examination procedures, exposure factors, and evaluation of radiography results.

2. Interview Guidelines

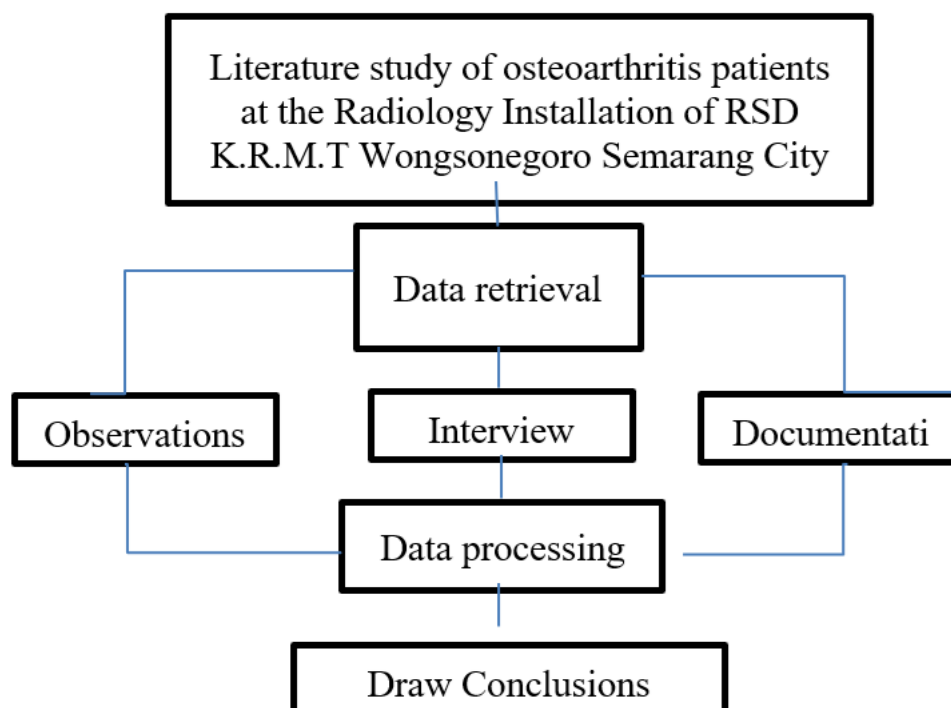
The researcher also used interview guidelines as a reference in obtaining information from radiographers and radiology specialists regarding *genu scanogram examination techniques*

3. Mobile

The researcher uses cellphones as a research support medium which aims to document and record the results of the researcher's interviews with radiographers and specialist doctors which will later be transcribed for later conclusions to be drawn.

After the data is collected, a narrative analysis is carried out through transcription, reduction, data grouping, and comparison with theory and conclusions are drawn. This research received approval from the Ethics Committee No.087/Kom.EtikRSWN/V/2026.

Research Flow:



In this study, data were obtained regarding radiography examination of *genu scanograms* in patients with clinical *osteoarthritis*. Based on the results of observations, interviews, and documentation by the author, the following data were obtained:

1. Case Exposure

a. Patient identity

Table 1. Patient Identity

Description	Patients
Name	M*****
Age	67
Gender	Women
No.RM	43****
Inspection Date	19 May 2026
Inspection	Gene scanogram
Diagnosis	Osteoarthritis

b. Patient History



The patient with the initials M, female, aged 67 years, came to the Radiology Installation of RSD K.R.M.T Wongsonegoro Hospital, Semarang City on May 19, 2026 with complaints of pain in both knees and difficulty walking. Based on a clinical examination, the patient was diagnosed *with bilateral genu osteoarthritis* so an AP long leg projection gene scanogram was carried out to evaluate *the alignment* of the lower extremities.

2. Inspection Procedure

a. Patient Preparation

The *genu scanogram examination* procedure with the *Osteoarthritis clinic* does not have any special preparation, only the patient is asked to remove metal objects that may interfere with the radiograph results or the occurrence of artifacts. Furthermore, the patient is positioned on the DR aid and given adequate education regarding the examination procedure, considering that the patient must maintain a standing position during the examination process. This education is important to ensure that the patient can follow the instructions properly and maintain the required position during the examination.

The statement is supported by the statement from informant 3 as follows:

"For *the genu scanogram*, there is no special preparation, it's just that the patient is asked to wear radiological clothing because this examination covers several parts ranging from the *femur* to the *ankle*, so make sure the patient has removed the metal object in the area or the patient is recommended to change radiological clothing" (I1/Radiographer)

For the *genu scanogram* examination in *osteoarthritis* patients does not have special preparation, we place the patient on a DR device, of course with good education, yes because usually for OA the patient is not able to stand for a long time. That's why we need to educate first to stand up later" (I3/Radiographer)

b. Preparation of tools and materials

The tools and materials used in the *genu scanogram* examination of *osteoarthritis patients* at the Radiology Installation of K.R.M.T Wongsonegoro Hospital, Semarang City, are Philips merx x-ray aircraft, Philips brand detectors measuring 35 x 43 cm, wall stands, and Philips brand computers are used to edit the image results The tools and materials used at the Radiology Installation of K.R.M.T Wongsonegoro Hospital Semarang City are as follows:

1) Digital X-ray Radiography



Figure 13. X-ray Plane

(Radiology Installation of RSD K.R.M.T Wongsonegoro Hospital, Semarang City, 2026)

2) Wall Stand



Figure 16. Wall Stand

(Radiology Installation of RSD K.R.M.T Wongsonegoro Hospital, Semarang City, 2026)

3) Long bone scale



Figure 17. Ruler

(Radiology Installation of RSD K.R.M.T Wongsonegoro Hospital, Semarang City, 2026)

The above statement is supported by the statement of informant 1 as follows:

"For the examination of tools and materials in the *genu scanogram* examination in *osteoarthritis* patients at the RSWN, it includes the first x-ray plane, it happens that here we use DR philips, continue to use *the wall spine*, then for this RSWN itself does not use tapes because here it is supported by *wall spine detector technology* that supports this examination to be carried out, then do not forget that there is a computer with the philips brand that is done to edit the results of the images produced." (I1/Radiographer)

c. Technology radiography

Based on the results of observations and interviews at the Radiology Installation of K.R.M.T Wongsonegoro Hospital, Semarang City, the examination technique in *Osteoarthritis* patients used *AP long leg projection*.

The examination technique starts from the patient being called to enter the examination room, then the patient is placed on an examination aid that already has a ruler to assist the doctor in reading or calculating the results of the *genu scanogram*. Usually in this examination, the patient uses an aid such as a cork as a medium to help prevent the patient's *ankle* from being cut during the examination. The patient holds on to the device to maintain the patient's balance during the examination. The examination is carried out with several exposures to the patient depending on the patient's height. Some of these exposures use the same exposure factor. The first exposure covers the pelvic area up to 1/3 proximal from the femur, then the exposure of the two parts of the genus itself with the aiming point in the middle of *the patella*, and the last exposure, which is the third, namely the *cruris* which covers from the genus to the ankle. During the examination, the tubes and detectors or if this examination uses a *wall stand* will move synchronously and automatically. Exposure is carried out when the patient is stationary and not moving. When the examination process is complete, instruct the patient to get off and invite the patient to come out. Then the image results will be recorded through an application on the radiography computer automatically. Editing is carried out by combining the three imaging results (*pelvis, femur, genu and cruris*) using the built-in application found on the radiography computer which makes a single radiography result contained in Fig.17.

The statement is supported by the statement from informant 3 as follows:

"For examination techniques, of course, it starts from the patient entering, usually the *long leg* examination starts from the *femur* to the *ankle*, usually for the *ankle* itself is not visible from the picture, we add a cork as a support to help the examination. Then we place the patient on the device, of course, with good education, yes because usually for OA the patient is not able to stand for a long time." (I3/ Radiographer)

The patient is positioned standing perpendicular to the beam on the aid mentioned earlier. The patient is positioned bilaterally with the direction of the vertical beam perpendicular to the tape, the FFD is set to 100 cm, the exposure factor is 60 kV and mAs 5. This examination is carried out with several exposures depending on the patient's own height. The first exposure includes the femur bone with *the central point* located in the middle of the *femur* bone with the boundary of the *femur collum* visible and the lower boundary of the *genu part* visible. Then for the second exposure, namely including the *genus* itself with *the central point* of the *pattela* with an upper boundary of 1/3 distal



femur and a lower boundary of about 1/3 of the proximal *tibia-fibula*. The last part of the exposure includes the *tibia fibula* to the *ankle*, with the *central point* located in the middle of the *tibia-fibula* with the upper boundary of the *genu* and the lower boundary of the *ankle joint*.

The statement is supported by the statement from informann 2 as follows:

"For the *scanogram* examination, we position the patient using aids for the *scanogram*, yes, like *genu* usually *genu osteoarthritis*, the examination is carried out with a bilateral AP position, we position the patient standing with a vertical beam perpendicular then we position it on the DR *long leg*, then we position the aids and we expose them, so in one examination there are three exposures with a *long leg scanogram*. (I2/ Radiographer)



Figure 17. Radiology results of long leg AP projection (Radiology installation of RSD K.R.M.T Wongsonegoro Semarang City, 2026)

d. Expert Results

The results of Mrs. M's patient experience on the *Genu Scanogram* examination with clinical *Osteoarthritis* are in accordance with the readings of radiology specialists in accordance with the Radiology Institution of K.R.M.T Wongsonegoro Hospital, Semarang City, namely:

X Photo *Scanogram* (Pelvis-femur-cruris Dextra Sinistra AP) Bone structure appears normal. No discontinuity in the bones is visible. No dislocation in the coxae, knee and *ankle joints*. *Varus angular deformity* appears in the *knee joint* dextra sinistra, HKA angle dextra = 8.4 ; HKA angle sinistra = 11.2. Intercondylar eminence are not pointed. Osteophyte appears. Narrowing of the *femorotibia dextra sinistra* joint was visible. Subcondral sclerosis and cyst formation were not visible. There was no soft tissue classification. Impression: *Varus angular deformity* in the *knee joint* dextra sinistra (HKA angle dextra = 8.4 and sinistra = 11.2). *Grade III duplex genus osteoarthritis* (Kellgren-Lawrance).

3. Reasons for Using AP Longleg Projection in Osteoarthritis Patients

The reason for the use of long leg AP projection in *Osteoarthritis patients* at the Radiology Installation of K.R.M.T Wongsonegoro Hospital, Semarang City is because the long leg DR examination (*genu scan*) in osteoarthritis cases provides a more optimal picture than conventional general radiography in assessing the narrowing and widening of joint space. This examination is carried out in a *weight-bearing position*, so that the body weight can provide a more realistic picture of the condition of the joint and allow for a clearer visualization of changes due to *osteoarthritis*. In addition to assisting the doctor in determining the severity (*grading*) of *osteoarthritis* as well as planning operative actions, such as the installation of a knee prosthesis, the *long leg projection* also allows an overall evaluation of the lower extremities. On a radiograph, the anatomy must appear complete from the *proximal femur* to the ankle, so that an assessment can be made of the alignment of the limbs, the width of the *genu* joint gap, and the *mechanical axis*. Mechanical axis measurements are performed by drawing a line from the center of the *head of the femur* to the center of the ankle joint to assess whether the line passes through the area of intercondylar eminence. In addition, this examination can indicate a shift in joint position due to *osteoarthritis* and help assess the degree of deformity, such as *varus* or *valgus*. which is the basis for clinical decision-making and therapy planning.

The statement is supported by the following statements from informants

"Well, for the usual examination, it is usually less than optimal to find out if there is a narrowing or relaxation of *Osteoarthritis* in the *genu*, therefore for DR *long leg*, it is possible to maximally see *osteoarthritis* in a way that



gets weight pressure so that the OA is maximally clear, and makes it easier for doctors to assess the *grade of Osteoarthritis* in the patient itself." (I1/ X-rayer)

"Because in patients with *osteoarthritis diagnosis* it is usually for the continuation of the *genus* that will be performed surgery which is usually done to replace *the pattela*, for the assessment of *this genu* anatomically from the tip of the base of *the femoris* to the *ankle* itself must be seen so it must be used a *long leg* projection, because from that projection it will be assessed from *The genu* itself is the *space* of the *genu* and then assessed as a whole, the assessment is seen from the pressure from the base of the *femur* to the *ankle*, like that" (I 2 / Radiographer)

"For this AP *long leg* projection, the first one is to be able to measure *the mechanical axis* if the doctor says so he can line from the femur flashlight to the ankle flashlight can be measured whether he passes *eminence*, then for his OA the shift can be seen. Then there is another advantage that it can see the angle whether he has a degree of deformity calculated on our own doctor, for example, for example, a patient with the same height or leg length can be seen from this *long leg projection*, either the patient has a difference in length of one to 3 centimeters on the patient's leg" (I 3 / Radiographer).

"Actually, the long leg AP projection alone is enough. It's just that if you want to add the lateral *weight bearing* projection, it is also okay to see *the condition of the pattela femoral*, because actually if you want to see the *femoral* pattela in the AP *long leg* projection itself, it is not very clear, but overall the long *leg AP* projection itself is enough." (I 4 / Radiology specialist)

Discussion

1. Genu Scanogram Examination Procedure in Osteoarthritis Patients

The procedure for *examining Genu Scanograms* in *Osteoarthritis patients* at the Radiology Installation of K.R.M.T Wongsonegoro Hospital, Semarang City, is patient preparation, preparation of tools and materials, and examination techniques.

a. Patient preparation

Patient preparation at the Radiology Installation of K.R.M.T Wongsonegoro Hospital, Semarang City does not have any special preparations, only before the examination is carried out, the patient is asked to remove metal objects around the examination area that can interfere with the radiography results. Furthermore, the patient is positioned on the DR aid and given adequate education regarding the examination procedure, considering that the patient must maintain a standing position during the examination process. This education is important to ensure that the patient can follow the instructions properly and maintain the required position during the examination.

According to Lampignano (2018), there is no special preparation for *the genu* radiography examination, only releasing metal objects around the object to be examined. According to Whitley (2015), it is stated that *the genu radiography examination* does not require special preparation. The preparations made include verifying the patient's identity and clinical requests, providing information about the examination procedure, removing metal objects that can interfere with the radiograph results, and adjusting the patient's position so that they can follow the instructions properly during the examination.

According to Rollins, Long, and Curtis (2022), it is explained that *genu radiography examination* does not require special preparation. Before the examination is performed, the radiographer needs to provide an explanation of the purpose and procedure of the examination to the patient so that the patient can cooperate well during the examination process. The patient is asked to remove metal objects that can cause artifacts in the radiographic image. In addition, the patient is positioned as comfortably as possible to facilitate the examination and reduce movements that can cause blurred images. The use of radiation shielding on areas that are not the object of examination is also recommended as long as it does not interfere with the anatomical area to be evaluated.

According to the author, the patient's preparation at the Radiology Installation of K.R.M.T Wongsonegoro Hospital, Semarang City is in accordance with the theory because there is no special preparation, only removing metal objects around the examination area that can interfere with the radiography image and the occurrence of artifacts.

b. Tools and Materials

The preparation of tools and materials at the Radiology Installation of K.R.M.T Wongsonegoro Hospital, Semarang City, is a Philips brand X-ray Aircraft, a Detector Reader with a size of 35 x 43 cm, a Wall Stand, and a ruler aid as a medium for measuring radiograph results.



According to Lampignano (2018), the preparation of tools and materials for *genu* examination in *Osteoarthritis* patients is an x-ray plane, examination table, 24 x 30 cm tape, markers, aprons, fixation tools. According to Long (2016), the preparation of tools and materials for *genu* radiography examination includes an x-ray plane, a 24 x 30 cm imaging plate, markers, gonad shields, and printers.

According to the author, the preparation of tools and materials at the Radiology Installation of K.R.M.T Wongsonegoro Hospital, Semarang City, there is a slight difference in the tools used, namely the use of a ruler that assists the doctor in reading and measuring the results of the image. The use of rulers on DR aids in long leg AP examinations at the Radiology Installation of K.R.M.T Hospital Wongsonegoro Semarang City has advantages in helping to improve the accuracy of bone length measurement and evaluation of *lower extremity alignment*, but its use still requires precision in placement and conformity to the patient's position so that the measurement results obtained are more precise, so in general it is recommended to standardize procedures for the use of tools, optimization of digital systems such as PACS, and continuous training for radiographers to maintain the consistency and accuracy of examination results in various health facilities.

c. Technology radiography

Based on the results of the author's observations, the *scanogram examination of the projection of AP Long leg* in this case is an initial examination carried out by the patient after the patient is diagnosed with *Osteoarthritis*, not as a *follow-up examination* of the previous examination. In addition, this examination is also carried out for evaluation of pre-op and post op actions.

The *genu scanogram examination technique* in *osteoarthritis patients* at the Radiology Installation of K.R.M.T Wongsonegoro Hospital, Semarang City, has been in accordance with the Standard Operating Procedures (SOP) applicable at the hospital. In the case of *genu examination* with indications of *osteoarthritis*, the procedure that is consistently applied only uses *AP long leg projection* as the main standard, without the addition of other radiographic projections. This shows that the examination has been carried out in a standardized manner according to the guidelines set by the Radiology Installation of K.R.M.T Wongsonegoro Hospital, Semarang City. The *genu scanogram examination* was carried out with the patient standing upright bilaterally facing the ray, using aids (ruler and cork), this examination used the same exposure factor, namely FFD 100 cm, an exposure factor of 60 kV/5 mAs, and several exposures were carried out depending on the height of the patient himself. The area of exposure includes: *femur*, *genu*, and *tibia-fibules to the ankle*. After several exposures, the patient is instructed to leave and then the image is edited on a radiographic computer to combine some of the exposures that were done.

Meanwhile, according to Lampignano (2018), in the *genographic examination* with *osteoarthritis* cases using *Weight bearing projection*. The purpose of the examination is to look at the narrowing of the joint gap to investigate the *valgus* and *varus* or commonly called bone bending of the *femur/tibia* bone in the area of the knee joint and lateral (*mediolateral*) to produce different radiographic criteria and reveal the anatomical, physiological and pathological structures of different positions of the knee joint. According to Whitley (2015), it is explained that in the *genous radiographic examination* with indications of *osteoarthritis*, the patient is positioned *supine AP* or standing with the lower extremities in a position of full extension and neutral rotation, with the patella facing anterior to obtain a symmetrical projection of the joint.

According to Long et al. (2022), *genu* radiography examination was carried out using *genu anteroposterior (AP) projection* with a *central ray* perpendicular to the *joint space of the femorotibial joint* as well as collimation that includes distal *femur* to proximal *tibia* for the evaluation of the structure of the knee joint in *osteoarthritis* cases. In line with this, several studies also mention that *AP genu projection* is a basic examination in the evaluation of *osteoarthritis* because it is able to show optimal narrowing of joint gaps and degenerative changes in the knee joint.

Research by Hasbi et al. (2025), states that genetic radiographic examination in *osteoarthritis* cases can be performed with *weight-bearing anteroposterior (AP) projection* or *supine AP*, each of which provides different anatomical information of the knee joint in the assessment of the degree of narrowing of the joint gap.

According to the author, the *gene-scanning examination technique* in *osteoarthritis patients* at the Radiology Installation of K.R.M.T Wongsonegoro Hospital, Semarang City, there is a difference with the theory, namely using long leg AP projection. This is different from the theory that states the *weight bearing projection* used in the examination of *osteoarthritis patients*. The authors argue that the difference in the *long-leg AP projection* used in *osteoarthritis* examination is due to the overall *alignment*, *varus* and *vagus deformities* that often accompany OA. This long leg AP examination uses two to three exposures that have the potential to increase dose accumulation, even though this technique has a high urgency value in mapping

the biomechanics of the entire lower limb that cannot be accommodated by ordinary gene photography. Based on the results of the study, the use of AP long leg projections is sufficient and appropriate to meet the purpose of *genu scanogram* examination in osteoarthritis patients. If there are certain clinical indications that require further evaluation of the structure of the knee joint, the radiographer may consider the use of additional projections such as lateral or other projections as requested and clinical needs.

2. Reasons for Using Long Leg AP Projection in Osteoarthritis Patients

The reason for the use of long leg AP projection in osteoarthritis patients at the Radiology Installation of K.R.M.T Wongsonegoro Hospital is that this examination, carried out in a *weight-bearing* position, provides a more optimal picture of joint gaps, mechanical axis, limb alignment, and degree of deformity (*varus/valgus*) from the proximal femur to the ankle compared to conventional genus radiography, thus supporting the determination of severity, planning of operative actions (e.g. knee prosthesis placement), and clinical decision-making.

Genu *varus* and genu *vagus* are deformities in the lower extremities characterized by changes in knee alignment. Genu *varus* causes the legs to appear to form the letter O (*bow-leg*) because the two knees are far apart when the ankles are together, while genu *vagus* causes the legs to appear to form the letter X (*knock-knee*) because the two knees are close to each other when the ankles are still far apart. In the *varus* genus *mechanical axis* shifts towards the medial, while in the *vagus* genu it shifts to the lateral direction causing an unequal distribution of the load at the knee joint (Paley, 2002).

Mechanical axis is an imaginary line used to assess the alignment of the lower extremities. This line is drawn from the center of the femoral head to the center of the ankle joint, and under normal conditions passes through the center of the knee joint. The *mechanical axis* is an important parameter in the evaluation of lower limb alignment because it describes the path of body load distribution in a weight-bearing position. Therefore, the assessment of the *mechanical axis* is widely used in radiographic examination of the lower extremities to evaluate limb alignment and support orthopedic action planning (Rivière et al., 2016).

According to Long (2016) to show a good osteoarthritis, using Weight Bearing projection aims to see the narrowing of the joint gap and to investigate the valgus and varus or the bending of the bones of the femur and tibia in the area of the knee joint. With the use of weight bearing projection, the pressure on the joint will increase. It is used to make it easier to see the straightness of the joint. The use of bilateral Weight Bearing is useful for comparing the narrowing of the joint (joint space).

Prastiwi et al. (2022), explained that radiographic examination of the knee joint in cases of osteoarthritis generally uses AP and lateral projection, which aims to evaluate the presence of narrowing of joint gaps, osteophyte formation, and changes in bone structure due to degenerative processes in the knee joint. In addition, Wolfe et al. (2002), emphasized that posterior anterior weight-bearing projection has an important role in the evaluation of genous osteoarthritis because it is able to describe the narrowing of the joint gap more accurately than the non-weight-bearing position, making it more representative in assessing the mechanical load on the knee joint.

According to the author, the use of longleg AP projection on the genu scanogram examination in osteoarthritis patients at the Radiology Installation of K.R.M.T Wongsonegoro Hospital, Semarang City was chosen because the projection is needed to evaluate the mechanical axis, measure the degree of varus and vagus deformity, and plan orthopedic actions accurately. This longleg AP scanogram examination uses two to three exposures that have the potential to increase dose accumulation, although this technique has a high urgency value in mapping the biomechanics of the entire lower limb that cannot be accommodated by ordinary gene photography. The authors also suggest that lateral projections may be added to support the doctor in establishing the diagnosis.

CONCLUSION

The procedure for examining the genu scanogram in osteoarthritis patients at the Radiology Installation of K.R.M.T Wongsonegoro Hospital, Semarang City has been in accordance with the standard in terms of patient preparation (removal of metal objects and education), but there are differences in the use of long bone scale tools and examination techniques that only use long leg AP projection (three exposures, weight-bearing position) without additional projections, in contrast to the theory that generally uses conventional weightbearing projection. The reason for using long leg AP projection is that it is able to provide a more optimal picture of joint gaps, mechanical axis, limb alignment, and degree of deformity (*varus/valgus*) from the proximal femur to the ankle, thus greatly supporting the determination of severity, planning of operative actions (e.g. knee prosthesis placement), and clinical decision-making.

Suggestions

The authors suggest the addition of lateral projections to help with a more complete diagnosis.



BIBLIOGRAPHY

- Anita Nur Mayani , Retno Herawati , Rizky Aprilia Firdhayusah. Procedure for Radiographic Examination of Knee Joint in Osteoarthritis Patients at Salatiga Regional General Hospital (2021)
- Bambang; Syam Ari F. Textbook of Internal Medicine. In: InternaPublishing. 2019. p. 4125–9
- Hasbi, N. A., Rusli, M., & Jamal, N. J. (2026). *Comparison of anatomical information of articulation genu examination of AP weight bearing and AP supine in cases of osteoarthritis in radiology installations*. Journal of Diagnostic Imaging (JImeD), 12(1), 1–5.
- Justinus Tambunan, Amry Siallagan (2023). Bilateral Knee Joint Radiographic Examination Procedure with Suspected Sub Luxatio Osteoarthritis at Columbia Asia Hospital Medan
- Kellgren, J. H., & Lawrence, J. S. (1957). *Radiological assessment of osteo-arthritis*. Annals of the Rheumatic Diseases, 16(4), 494–502.
- Lampignano, John P., dan Kendrick, Leslie E. 2018. Bontrager's Textbook of Radiographic Positioning and Related Anatomy. Ninth Edition. Elsevier, Inc. St. Louis
- Long,B.W.,Rollins,J.H.danSmith,B.J.(2016)RADIOGRAPHICPOSITIONING&PROCEDURES.13ed.Missouri; Elsevier.
- Makiza Ignes Juvellin, Aninda Putri, Dita Amelia Putri, Fatwa Salsabila (2024). Knee Joint Radiographic Examination Technique with Osteoarthritis Clinic at the Radiology Installation of dr. Loekmono Hadi Kudus Hospital
- Mohan,H.(2015)text ofpatology.sevantedi.DieditolehP.Mohan., T.Mohan,dan,S.Mohan.Katmandu;jaypeebrothersmedicalpublisher(p)Ltd.
- Paley, D. (2002). *Principles of Deformity Correction*. Springer.
- Pearce, C.evely. (2012)anatomyandphysiology.jakarta;PT gramediapustaka Utama
- Prayoga, A. N., & Sulistyowati, I. (2024). Empowerment of PKK Mothers in Educating Genu Radiography Examination to Detect Osteoarthritis Cases in Kendal Regency, Central Java Province. Scientific Journal of Community Empowerment (JIPMK). Definition and projection of weight bearing
- Reichma,W.M.,Maillefert,J.F.danHunter,D.J.(2011)"sytematicreview,"19
- Rivière, C., Iranpour, F., Auvinet, E., Howell, S., Vendittoli, P. A., Cobb, J., & Parratte, S. (2016). *Mechanical and kinematic alignment in total knee arthroplasty*.
- Rollins, J. H., Long, B. W., & Curtis, T. (2022). *Merrill's Atlas of Radiographic Positioning and Procedures* (15th ed.). St. Louis, MO: Elsevier
- Setiati, Siti; Alwi, Idrus; Sudoyono, Aru. W; K. Simadibrata, Marcellus; Setiyohadi, Siti Afifah, Ilds Maulidya M.N, Puput Khusniatul Majidah. Literature Study of Knee Joint Radiographic Examination Techniques in Osteoarthritis Cases (2021)
- Study P, Program R, Three D, Health FI. OSTEOARTHRITIS IN THE RADIOLOGY INSTALLATION OF UNS HOSPITAL" KTI PROPOSAL Prepared by: 2024; (September).
- Sugiyono (2014) Quantitative, qualitative, and R&D research methods, 19thedn. Bandung: ALFSBETA, CV.
- Swastini, N. P., Ismunandar, H., Wintoko, R., Hadibrata, E., & Djausal, A. N. (2022). Risk Factors for Osteoarthritis.
- Thahira, Y. M., Latief, J., Kuswardhana, H., Sam, A. D. P., & Amba, E. G. (2024) Incidence of Osteoarthritis in the Years 2018 – 2022. Fakumi Medical Journal.
- Whitley, A. S., Sloane, C., Hoadley, G., Moore, A. D., & Alsop, C. W. (2015). *Clark's Positioning in Radiography* (13th ed.). Boca Raton: CRC Press
- Rollins, J. H., Long, B. W., & Curtis, T. (2022). *Merrill's Atlas of Radiographic Positioning and Procedures* (15th ed.). St. Louis, MO: Elsevier
- Setiati, Siti; Alwi, Idrus; Sudoyono, Aru. W; K. Simadibrata, Marcellus; Setiyohadi, Siti Afifah, Ilds Maulidya M.N, Puput Khusniatul Majidah. Literature Study of Knee Joint Radiographic Examination Techniques in Osteoarthritis Cases (2021)
- Study P, Program R, Three D, Health FI. OSTEOARTHRITIS IN THE RADIOLOGY INSTALLATION OF UNS HOSPITAL" KTI PROPOSAL Prepared by: 2024; (September).
- Sugiyono (2014) Quantitative, qualitative, and R&D research methods, 19thedn. Bandung: ALFSBETA, CV.
- Swastini, N. P., Ismunandar, H., Wintoko, R., Hadibrata, E., & Djausal, A. N. (2022). Risk Factors for Osteoarthritis.
- Thahira, Y. M., Latief, J., Kuswardhana, H., Sam, A. D. P., & Amba, E. G. (2024) Incidence of Osteoarthritis in the Years 2018 – 2022. Fakumi Medical Journal.
- Whitley, A. S., Sloane, C., Hoadley, G., Moore, A. D., & Alsop, C. W. (2015). *Clark's Positioning in Radiography* (13th ed.). Boca Raton: CRC Pres