

planning and positioning in mri Tutorial

Introduction to Planning and Positioning in MRI

Planning and positioning in MRI are fundamental components that determine the quality of imaging, patient safety, and diagnostic accuracy. Magnetic Resonance Imaging (MRI) is a sophisticated imaging modality used extensively in medical diagnostics to visualize soft tissues, organs, and other internal structures with high resolution. Proper planning and positioning ensure that the MRI scan captures the most relevant anatomy while minimizing artifacts, reducing scan time, and enhancing patient comfort. This article explores the essential aspects of planning and positioning in MRI, including techniques, protocols, and best practices to optimize imaging outcomes.

Understanding the Importance of Planning in MRI

Planning in MRI involves meticulous preparation before the actual scan begins. It includes selecting the appropriate imaging protocols, understanding the patient's clinical needs, and determining the optimal imaging planes and sequences.

Key Objectives of Planning in MRI

- Maximize diagnostic information
- Minimize scan time and patient discomfort
- Reduce motion artifacts
- Ensure patient safety
- Optimize image resolution and contrast

Steps in Effective MRI Planning

- Review Patient History and Clinical Indications

Understand the clinical question to tailor the imaging protocol accordingly. For example, neurological, musculoskeletal, or abdominal scans require different sequences and planes.

- Select Appropriate Imaging Protocols

Choose sequences that best visualize the targeted anatomy, such as T1-weighted, T2-weighted, diffusion-weighted imaging, or contrast-enhanced studies.

- Determine the Imaging Planes and Coverage

Decide on axial, sagittal, coronal, or oblique planes based on the anatomy and clinical suspicion.

- Prepare the Patient

Explain the procedure, address contraindications, and prepare the patient for optimal positioning.

Positioning in MRI: Principles and Techniques

Positioning is the process of aligning the patient accurately within the MRI scanner to obtain high-quality images of the intended anatomy.

Fundamentals of Proper Positioning

- Ensuring the targeted anatomy is centered within the magnetic field
- Achieving comfortable and stable patient posture
- Minimizing movement during the scan
- Aligning the patient according to the planned imaging planes

Common Positioning Strategies

- Supine position (most common for brain, spine, and extremities)
- Prone or lateral positions as needed
- Use of immobilization devices to prevent motion
- Padding and supports for patient comfort

Positioning for Specific Anatomical Regions

- Head and Neck: Use headrests and immobilizers; align the Frankfurt plane parallel to the floor.
- Spine: Ensure the patient is centered along the sagittal midline; use foam pads for stabilization.
- Extremities: Position limb in neutral or functional posture; immobilize if necessary.
- Abdominal and Pelvic: Position supine with arms raised or along the body; use cushions to

reduce movement.

Optimizing Patient Positioning for Diagnostic Accuracy

Proper positioning enhances the clarity and diagnostic utility of MRI images.

Techniques to Improve Positioning

- Use of laser alignment systems to mark the isocenter
- Applying external markers or fiducials for precise localization
- Adjusting table height and tilt for better access
- Communication with the patient to maintain stillness

Common Challenges and Solutions

- Patient movement: Use immobilization devices and instruct the patient
- Anatomical variations: Adjust positioning devices accordingly
- Obesity or limited mobility: Use specialized coils and supports

Role of Advanced Positioning Devices and Techniques

Innovations have enhanced positioning accuracy and patient comfort.

Positioning Aids and Devices

- Cushions, pads, and wedges
- Immobilization straps and braces
- Customized molds and molds
- Positioning frames for extremities

Technological Advances in Positioning

- Automated positioning systems with laser guidance
- 3D cameras and sensors for real-time alignment
- Motion correction algorithms

Protocols and Standardization in MRI Planning and Positioning

Consistency is critical in MRI to achieve reproducible and comparable results.

Developing Standard Protocols

- Define imaging sequences and parameters for common examinations
- Establish positioning landmarks and reference points
- Incorporate safety checks and patient-specific considerations

Benefits of Standardization

- Improved image quality
- Reduced scan times
- Enhanced reproducibility
- Better inter-observer consistency

Safety Considerations in MRI Planning and Positioning

Safety is paramount in MRI due to the strong magnetic fields and specific equipment.

Key Safety Aspects

- Screening for contraindications such as metallic implants
- Ensuring no ferromagnetic objects are present
- Proper patient immobilization to prevent injury
- Monitoring for claustrophobia and providing sedation if needed

Positioning and Safety

- Avoiding pressure points and nerve compression
- Using appropriate supports to prevent falls
- Confirming correct coil placement to avoid burns or discomfort

Conclusion and Best Practices

Effective planning and positioning are essential for high-quality MRI imaging, accurate diagnosis, and patient safety. Radiologists and technologists should collaborate closely, utilize advanced positioning devices, and adhere to standardized protocols. Continuous training and technological

updates further enhance the efficacy of MRI procedures. By meticulously preparing and positioning patients, healthcare providers can ensure optimal imaging outcomes, leading to better patient care.

Summary of Key Points

- Thorough planning involves understanding clinical needs, selecting appropriate protocols, and preparing the patient.
- Precise positioning ensures targeted anatomy is optimally visualized while minimizing artifacts.
- Use of advanced tools and techniques enhances positioning accuracy and patient comfort.
- Standardized protocols promote reproducibility and diagnostic consistency.
- Safety measures are integral throughout the planning and positioning process.

Implementing these best practices in MRI planning and positioning ultimately contributes to more accurate diagnoses, improved patient experiences, and efficient use of imaging resources.

Planning and positioning in MRI is a critical aspect of achieving high-quality imaging, accurate diagnosis, and efficient workflow. Proper planning ensures that the region of interest is optimally visualized, minimizing artifacts and maximizing the diagnostic yield. Positioning, on the other hand, involves aligning the patient correctly within the scanner to facilitate precise imaging planes and reduce the need for repeat scans. Together, these elements form the foundation of successful MRI examinations and significantly influence patient comfort, scan time, and image quality.

Understanding the Importance of Planning in MRI

Planning in MRI encompasses the pre-scan activities that determine how the scan will be performed, including selecting the appropriate imaging protocols, determining the scan planes, and identifying the target anatomy. Effective planning is essential because it directly impacts the diagnostic utility of the images produced.

Objectives of Planning

- To accurately target the area of interest
- To optimize image resolution and contrast
- To reduce scan time and patient discomfort
- To minimize the need for repeat scans
- To ensure safety, especially in patients with implants or contraindications

Key Components of MRI Planning

- Patient positioning: Ensuring the patient is correctly aligned on the scanner table.
- Anatomical localization: Using scout images or localizers to identify the precise anatomy.
- Selection of imaging planes: Choosing axial, sagittal, coronal, or oblique planes based on the clinical question.
- Determination of parameters: Adjusting parameters such as slice thickness, field of view (FOV), and matrix size.
- Protocol selection: Deciding on the pulse sequences and contrast settings appropriate for the examination.

Positioning in MRI: Principles and Practice

Positioning in MRI involves the correct placement of the patient within the magnet bore to ensure optimal imaging of the target anatomy. Proper positioning reduces artifacts, improves spatial resolution, and enhances patient comfort.

Fundamentals of Patient Positioning

- Alignment with the magnet bore: The area of interest should be centered in the scanner to maximize the uniformity of the magnetic field.
- Stability and comfort: Proper supports and padding should be used to keep the patient still and reduce movement artifacts.
- Reproducibility: Consistent positioning allows for reliable comparisons across multiple scans or follow-ups.

Common Positioning Techniques

- Supine position: Most common, suitable for brain, spine, and extremities.
- Prone position: Used for breast imaging or specific abdominal studies.
- Lateral decubitus: Sometimes employed for lung or thoracic imaging.
- Customized positioning devices: Such as headrests, foam pads, or immobilization devices to improve comfort and stability.

Techniques for Effective Planning and Positioning

Effective planning and positioning require a combination of technical knowledge, patient communication, and careful use of imaging tools.

Utilizing Scout or Localizer Images

- These initial images help identify the precise anatomy and plan subsequent sequences.
- They are usually acquired in multiple planes to provide a comprehensive overview.

Choosing the Correct Imaging Planes

- Plane selection should be based on the anatomical orientation and clinical question.
- Oblique planes can be used to visualize structures at angles not aligned with standard planes.

Patient Positioning Strategies

- Use of adjustable supports and cushions to maintain alignment.
- Verifying positioning with preliminary images before proceeding with detailed sequences.
- Communicating clearly with the patient to ensure cooperation and reduce movement.

Advancements and Technologies Aiding Planning and Positioning

Modern MRI systems incorporate advanced tools to facilitate precise planning and positioning, enhancing both image quality and patient experience.

Image-Guided Positioning

- Some systems feature real-time feedback and positioning aids such as laser guides.
- 3D cameras and tracking systems can assist in aligning the patient accurately.

Automated Positioning and Protocol Selection

- Software algorithms can suggest optimal positioning based on patient anatomy.
- Predefined protocols streamline the process, reducing human error.

Patient Comfort Enhancements

- Noise reduction technologies
- Faster sequences
- Open MRI designs for claustrophobic patients

Challenges and Limitations

Despite technological advancements, planning and positioning in MRI still face challenges:

- Patient movement: Can cause significant artifacts, necessitating re-positioning or repeat scans.
- Anatomical variations: Individual differences may complicate standard positioning techniques.
- Time constraints: Busy clinical settings require efficient workflows, which can sometimes compromise meticulous planning.
- Contraindications and implants: These require additional considerations during planning to ensure safety.

Pros and Cons of Planning and Positioning in MRI

Pros

- Enhanced image quality and diagnostic accuracy
- Reduced need for repeat scans, saving time and resources
- Improved patient comfort and cooperation
- Better utilization of scanner capabilities
- Increased safety, especially in patients with implants

Cons

- Time-consuming initial setup
- Requires skilled technicians and thorough training
- Potential for human error in positioning
- Variability in patient anatomy and compliance
- Additional costs for positioning aids and accessories

Conclusion

Planning and positioning in MRI are integral components that determine the success of an imaging study. A meticulous approach, leveraging modern technology, and effective communication with patients can significantly improve image quality, reduce artifacts, and enhance overall workflow efficiency. As MRI technology continues to evolve, so too will the tools and techniques for planning and positioning, making procedures faster, safer, and more comfortable for patients. For radiologists and technologists alike, mastering these aspects is essential for providing high-quality, accurate diagnostic imaging and optimal patient care.

QuestionAnswer What is the importance of proper planning in MRI to ensure accurate imaging

results? Proper planning in MRI ensures optimal positioning of the patient and the region of interest, which enhances image quality, reduces scan time, and minimizes the need for repeat scans, ultimately leading to accurate diagnosis. How does patient positioning impact the quality of MRI images? Patient positioning affects the alignment of the anatomy within the magnetic field and coil, reducing artifacts and ensuring consistent, high-quality images that accurately represent the area being examined. What are key considerations when planning MRI scans for musculoskeletal imaging? Key considerations include proper patient positioning to visualize the target joint or tissue, use of appropriate coils, minimizing motion artifacts, and ensuring the region of interest is centered and aligned within the magnetic field. How can positioning errors affect MRI diagnostic outcomes? Positioning errors can cause image distortion, incomplete visualization of pathology, or artifacts, which may lead to misdiagnosis or the need for repeat scans, delaying treatment. What role does planning play in reducing scan time and improving MRI efficiency? Effective planning ensures precise targeting of the area of interest, optimal patient positioning, and selection of appropriate sequences, all of which contribute to shorter scan times and increased workflow efficiency. Are there specific techniques or tools used for optimal positioning in MRI? Yes, techniques such as immobilization devices, positioning aids, and careful patient instruction are used to achieve consistent and accurate positioning, along with planning the scan protocol tailored to the patient's anatomy and clinical needs.

Related keywords: MRI planning, patient positioning, imaging protocols, anatomical landmarks, scan parameters, coil selection, slice orientation, image quality, diagnostic accuracy, workflow optimization

clark positioning in radiography

Clark Positioning in Radiography

In the field of diagnostic imaging, radiographic positioning plays a crucial role in obtaining high-quality images that accurately depict anatomical structures for precise diagnosis. Among various positioning techniques, Clark positioning is a fundamental method used primarily in chest radiography and certain other examinations. This positioning ensures optimal visualization of thoracic organs, minimizes radiation exposure, and enhances image clarity. Understanding Clark positioning, its principles, applications, and techniques is essential for radiologic technologists and students aiming to improve image quality and patient outcomes.

Understanding Clark Positioning in Radiography

Clark positioning is a specific radiographic positioning technique designed to optimize the

visualization of the thoracic cavity, particularly the lungs, heart, and mediastinum. It involves precise patient alignment and technical considerations to achieve the best possible image quality while reducing the need for repeat exposures.

This positioning is named after the radiologic technologist or clinician credited with its development or popularization, emphasizing its historical and practical importance in radiography.

Principles of Clark Positioning

The core principles of Clark positioning revolve around anatomical alignment and radiation safety:

- Maximizing Lung Field Visibility: Proper positioning ensures that the entire lung fields are captured, including apices and costophrenic angles.
- Reducing Oesophageal and Cardiac Shadowing: Correct patient alignment minimizes superimposition of structures, providing clear differentiation between mediastinal and pulmonary tissues.
- Minimizing Patient Dose: Proper positioning reduces the need for repeated exposures, thereby lowering radiation dose.
- Standardization: Clark positioning follows standardized protocols to ensure consistency and comparability across different imaging sessions.

Applications of Clark Positioning in Radiography

Clark positioning is predominantly used in:

- Chest Radiography: Both posteroanterior (PA) and anteroposterior (AP) views.
- Lung Imaging: To evaluate pulmonary pathologies such as pneumonia, tumors, or pleural effusions.
- Mediastinal Imaging: For better visualization of mediastinal structures.
- Preoperative and Postoperative Assessments: To evaluate surgical outcomes or disease progression.

Techniques and Steps of Clark Positioning

Achieving the correct Clark position requires meticulous attention to patient placement and technical parameters. The following steps outline the standard procedure:

Preparation

- Verify patient identity and clinical indications.
- Explain the procedure to ease patient cooperation.
- Ensure patient comfort and immobilization.
- Remove any clothing, jewelry, or accessories that may obscure anatomy.
- Adjust room lighting for optimal viewing.

Patient Positioning

- For PA Chest View:
 - Have the patient stand erect facing the upright image receptor.
 - Position the chin slightly elevated to prevent superimposition over the apices.
 - Place the hands on the hips or behind the head as per protocol.
 - Instruct the patient to take a deep breath and hold to expand the lungs fully.
 - Ensure the chest is in contact with the image receptor, with the mid-sagittal plane centered.
 - Adjust the patient's shoulders to be symmetric and the scapulae moved laterally.
- For AP Chest View (commonly in bedridden patients):
 - Position the patient supine or semi-supine with the back against the image receptor.
 - Center the chest to the detector.
 - Follow similar instructions for breath-hold.

Alignment and Central Ray Placement

- Align the central ray perpendicular to the image receptor.
- For PA views, direct the central ray at the T7 vertebral level, approximately 7-8 inches below the vertebral prominens.
- For AP views, the same level applies but with different patient orientation.
- Ensure the patient's chest is positioned symmetrically to avoid rotation.

Position Verification

- Check for proper alignment:
- The patient's shoulders should be symmetric.

- The clavicles should be equidistant from the vertebral column.
- The spinous processes should be centered.
- Confirm that the patient is standing or lying upright, as required.
- Ensure the patient holds their breath during exposure to prevent motion artifacts.

Key Factors for Successful Clark Positioning

To ensure optimal radiographs, consider these critical factors:

- Patient Cooperation: Clear instructions for breathing and remaining still.
- Proper Alignment: Ensuring the vertebral column is centered and free of rotation.
- Correct Central Ray Placement: Accurate at the T7 level.
- Adequate Inspiration: Deep breath to fully expand the lungs.
- Equipment Settings: Appropriate kVp and mAs settings based on patient size and clinical need.

Common Challenges and Solutions in Clark Positioning

Despite its straightforward nature, several challenges may arise:

- Patient Inability to Stand or Hold Breath:
 - Use AP projections if the patient cannot stand.
 - Use shorter exposure times or immobilization devices.
- Rotation of the Patient:
 - Confirm patient alignment by checking clavicular and rib symmetry.
 - Adjust patient position as needed.
- Inadequate Inspiration:
 - Provide clear instructions.
 - Repeat the exposure if necessary.
- Superimposition of Structures:
 - Adjust patient position to minimize superimposition.
 - Use proper angulation if required.

Advantages of Clark Positioning

Implementing Clark positioning offers several benefits:

- Produces high-quality, diagnostic images.
- Facilitates accurate assessment of lung and mediastinal pathology.
- Reduces the likelihood of repeat exposures, minimizing radiation dose.
- Standardizes imaging protocols for consistency across different facilities.

Conclusion

Clark positioning in radiography is a vital technique in thoracic imaging that enhances the clarity and diagnostic value of chest radiographs. Its emphasis on precise patient positioning, alignment, and technical parameters ensures that clinicians receive accurate representations of thoracic anatomy. Mastery of Clark positioning requires understanding anatomical landmarks, patient communication, and technical skills. By adhering to standardized protocols and troubleshooting common challenges, radiologic technologists can deliver optimal imaging outcomes, ultimately contributing to improved patient care and diagnostic accuracy.

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Clark Positioning in Radiography: A Comprehensive Guide

Clark positioning is a fundamental technique in radiographic imaging that plays a crucial role in obtaining accurate, high-quality diagnostic images. Named after the radiographer who pioneered or popularized the method, Clark positioning involves specific patient alignment and centralization strategies designed to optimize visualization of particular anatomical structures. A thorough understanding of this positioning technique is essential for radiologic technologists aiming to improve image quality, reduce repeats, and ensure patient safety.

Introduction to Clark Positioning

Clark positioning is a specialized radiographic method employed mainly for imaging certain joints, bones, or regions where standard positioning might not provide sufficient clarity or diagnostic detail. The technique emphasizes precise patient placement, central beam alignment, and proper

immobilization to achieve optimal visualization.

This positioning method is particularly valuable in:

- Imaging complex or overlapping anatomical structures
- Visualizing small or intricate bones
- Reducing superimposition of adjacent tissues
- Enhancing contrast and detail in the region of interest

Historical Background and Etymology

While the exact origin of Clark positioning remains somewhat obscure, it is named after the radiographer or clinician associated with its development or popularization. Its historical evolution has been driven by the need for more refined imaging techniques that could address limitations in earlier radiographic methods.

Understanding this background provides context for its applications and underscores the importance of precise technique in achieving diagnostic success.

Principles of Clark Positioning

The core principles underpinning Clark positioning include:

- Precise patient alignment to the central ray
- Proper immobilization to prevent motion artifacts
- Minimization of superimposition of surrounding tissues
- Optimal beam angulation to target specific structures
- Use of positioning aids and supports for stability

These principles aim to produce images with high spatial resolution, contrast, and diagnostic clarity.

Common Indications for Clark Positioning

Clark positioning is indicated in various clinical scenarios, including but not limited to:

- Detailed imaging of small joints such as the wrist, hand, or foot
- Evaluation of fractures involving complex anatomy
- Visualization of specific anatomical landmarks (e.g., carpal bones)

- Preoperative planning for orthopedic interventions
- Assessment of degenerative changes in small bones

Knowing when and why to utilize Clark positioning ensures that radiographers select the most appropriate technique for each patient.

Detailed Steps in Clark Positioning

Implementing Clark positioning involves a systematic approach that ensures accuracy and reproducibility. The general steps include:

1. Patient Preparation

- Explain the procedure to the patient to ensure cooperation.
- Remove any clothing, jewelry, or accessories that may interfere.
- Position the patient comfortably, ensuring stability.

2. Anatomical Landmarks Identification

- Identify key landmarks relevant to the region (e.g., wrist crease, dorsum of hand).
- Use these landmarks to guide positioning.

3. Patient Alignment

- Position the patient so that the part of interest is accessible and correctly oriented.
- For extremity imaging, the limb is usually placed on a radiolucent support or table.

4. Central Ray Positioning

- Determine the central ray based on the specific structure targeted.
- Use a protractor or positioning device to align the central beam precisely.

5. Beam Angulation and Collimation

- Adjust the tube angle if necessary to project the anatomy in the desired plane.
- Collimate to restrict the beam to the region of interest, reducing radiation dose.

6. Immobilization and Stabilization

- Use sandbags, sponges, or immobilization devices to prevent movement.
- Ensure patient comfort to reduce involuntary motion.

7. Image Acquisition

- Confirm correct positioning via preliminary checks.
- Capture the radiograph with appropriate exposure factors.

Specific Clark Positioning Techniques for Common Regions

Different anatomical regions require tailored Clark positioning approaches. Below are some common examples:

1. Wrist (Carpal Bones)

- Position the patient seated or supine with the arm extended.
- Place the hand palm down (pronated) on the image receptor.
- Adjust the central ray to enter at the midcarpal area, angling if necessary to open joint spaces.
- Use a slight ulnar deviation to spread the carpal bones for better visualization.

2. Hand

- Hand placed flat on the IR with fingers extended.
- Central ray directed perpendicular to the third digit's PIP joint.
- For oblique views, rotate the hand externally to 45°.

3. Foot

- Patient supine or seated with the foot placed flat on the IR.
- To visualize the dorsal aspect, position the foot in a dorsiflexed position.
- Central ray directed through the midfoot, angling as needed for specific views.

4. Ankle

- Patient supine with the foot dorsiflexed.
- Central ray directed through the ankle joint, with optional medial or lateral obliques depending on the structure of interest.

Advantages of Clark Positioning

Implementing Clark positioning offers several benefits:

- Enhanced Visualization: Precise alignment improves the visibility of small or overlapping structures.
- Reduced Repeats: Accurate initial positioning decreases the need for retakes, minimizing radiation exposure.
- Better Diagnostic Accuracy: Clearer images facilitate more accurate diagnoses.
- Patient Comfort: Proper immobilization and positioning reduce discomfort and movement.

Limitations and Challenges

Despite its advantages, Clark positioning also presents certain limitations:

- Technical Skill Required: It demands precise knowledge of anatomy and positioning techniques.
- Patient Factors: Patients with limited mobility, pain, or deformities may find it difficult to assume the required position.
- Time-Consuming: Detailed positioning may take longer, especially in complex cases.
- Equipment Dependence: Requires appropriate supports, immobilizers, and positioning aids.

Tips for Effective Clark Positioning

- Always verify anatomical landmarks before positioning.
- Use positioning aids to enhance stability.
- Communicate clearly with the patient to ensure cooperation.
- Double-check beam alignment and collimation.
- Practice regularly to improve accuracy and efficiency.
- Document positioning details thoroughly for future reference.

Conclusion

Clark positioning remains a vital technique in the radiographer's repertoire, especially for imaging small, complex, or overlapping anatomical structures. Its emphasis on precise patient alignment,

beam angulation, and immobilization ensures high-quality images that are crucial for accurate diagnosis and effective treatment planning.

Mastery of Clark positioning requires a combination of anatomical knowledge, technical skill, and patient communication. When executed correctly, it significantly enhances the diagnostic utility of radiographic images, ultimately contributing to better patient outcomes.

Continuing education, practice, and familiarity with various regional techniques will help radiologic technologists optimize their use of Clark positioning in everyday clinical practice.

Question What is the primary purpose of Clark positioning in radiography? Clark positioning is primarily used to visualize the clavicle and acromioclavicular joint, helping to assess shoulder injuries and clavicular fractures with optimal clarity. **Answer** How is Clark positioning performed for shoulder imaging? In Clark positioning, the patient is seated or standing with the back against the image receptor, and the arm is abducted and externally rotated to elevate the shoulder, emphasizing the clavicle and acromioclavicular joint for clear imaging. What are the key advantages of using Clark positioning in radiography? Clark positioning provides a better view of the clavicle and acromioclavicular joint, reduces superimposition of surrounding structures, and enhances fracture detection and joint assessment. Are there specific patient conditions where Clark positioning is contraindicated? Yes, patients with shoulder dislocation, severe pain, or limited mobility may not tolerate Clark positioning, and alternative imaging techniques should be considered in such cases. How does Clark positioning differ from other shoulder radiographic views? Unlike standard AP views, Clark positioning involves specific arm abduction and external rotation to project the clavicle and acromioclavicular joint more clearly, often used as an adjunct for detailed assessment. What are common errors to avoid when performing Clark positioning? Common errors include inadequate arm abduction or external rotation, poor patient positioning leading to superimposition, and improper centering, which can compromise image quality. In what clinical scenarios is Clark positioning particularly recommended? Clark positioning is especially recommended when evaluating suspected clavicular fractures, acromioclavicular joint separations, or detailed shoulder trauma assessment where standard views are insufficient.

Related keywords: Clark positioning, radiographic positioning, clavicle imaging, shoulder radiography, clavicle technique, radiographic anatomy, patient positioning, shoulder X-ray, clavicle fracture, radiology positioning

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