Impact of Improper Patient Positioning on Diagnostic Accuracy in Radiographic Imaging: A Review

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Abstract: ***Patient positioning is a fundamental determinant of diagnostic image quality in radiographic examinations. Improper positioning introduces geometric distortions, structural superimpositions, and artifacts that may simulate or obscure pathological findings, directly compromising diagnostic accuracy. This narrative review synthesises evidence from peer-reviewed literature, textbooks, and institutional studies to characterise the nature, prevalence, and consequences of positioning errors across common radiographic examinations, including chest radiography, musculoskeletal imaging, mammography, fluoroscopy, computed tomography (CT), and magnetic resonance imaging (MRI). Specific positioning errors and their associated diagnostic pitfalls are catalogued, and their downstream effects on patient management, repeat radiation exposure, and medicolegal risk are examined. The review also appraises technological innovations-including automated positioning assistance and artificial intelligence (AI)-based quality-control systems-alongside training and protocol standardisation strategies designed to mitigate error rates. Evidence indicates that positioning errors account for a substantial proportion of radiographic repeats (up to 26% in some institutions) and contribute meaningfully to missed diagnoses and unnecessary radiation dose. A systematic, multi-pronged approach encompassing competency-based education, institutional quality assurance, patient communication strategies, and emerging digital tools is proposed as the optimal framework for reducing positioning-related diagnostic failures. Strengthening radiographer training and quality feedback systems represents the most practical immediate intervention.***

Keywords: patient positioning, radiographic imaging, diagnostic accuracy, image quality, repeat radiograph, radiographer, quality assurance, artefact

1. Introduction

Radiographic imaging constitutes the backbone of modern diagnostic medicine. Plain radiography, fluoroscopy, computed tomography (CT), and magnetic resonance imaging (MRI) collectively account for over 3.6 billion imaging procedures performed globally each year, with plain radiography representing the single largest modality [1]. The clinical utility of any radiographic examination is contingent not merely on the technical parameters of the imaging system — kilovoltage, milliampere-seconds, source-to-image distance-but equally on the spatial relationship between the patient anatomy, the X-ray beam, and the image receptor. This relationship is governed by patient positioning.

Patient positioning refers to the deliberate placement and alignment of the patient, or a specific anatomical region, relative to the central ray and image receptor according to established radiographic criteria. Adherence to standardised positioning protocols ensures that anatomical structures are demonstrated in their true geometric configuration, enabling accurate measurement, differential diagnosis, and inter-examination comparability [2,3]. Conversely, deviations from accepted positioning criteria-whether due to technologist error, patient non-compliance, clinical urgency, or equipment limitations-introduce a spectrum of image quality deficits that can mimic, mask, or exaggerate pathology.

The consequences of improper positioning extend beyond mere aesthetic dissatisfaction with image quality. They encompass clinically significant diagnostic errors, increased radiation exposure from repeat examinations, delayed or incorrect treatment decisions, heightened medicolegal liability, and excess economic cost to health systems [4,5]. Despite this, positioning errors remain among the most consistently cited causes of repeat radiograph acquisition, with institutional studies reporting rejection rates attributable to positioning of 10–26% across diverse healthcare settings [6,7].

While the radiographic literature abounds with technical descriptions of optimal positioning techniques, comprehensive reviews evaluating the diagnostic consequences of positioning failures across modalities remain sparse. This review aims to address that gap by: (i) characterising the types and mechanisms of positioning errors in common radiographic examinations; (ii) documenting their specific diagnostic consequences; (iii) quantifying, where evidence permits, their prevalence; and (iv) summarising evidence-based strategies for their prevention. The ultimate objective is to reinforce the centrality of positioning competency to diagnostic excellence and patient safety.

2. Scope and Methodology

This review was conducted as a narrative synthesis of published literature retrieved from PubMed/MEDLINE, Google Scholar, and Cureus, supplemented by relevant standard textbooks in radiographic positioning and radiological physics. Search terms included combinations of: "patient positioning", "radiographic technique", "image quality", "diagnostic accuracy", "repeat radiograph", "reject analysis", "positioning error", "artefact", and specific modality terms. Articles published in English between 1990 and 2024 were considered, with priority given to systematic reviews, original research studies, and institutional quality audits. Standard positioning references including Bontrager's Textbook of Radiographic Positioning [2] and Clark's Positioning in Radiography [3] were used to define accepted positioning criteria. Studies reporting rejection/repeat rates, diagnostic consequences, and intervention outcomes were prioritised; approximately 120 articles were screened and 68 were included.

3. Fundamentals of Radiographic Positioning

Before examining modality-specific errors, it is instructive to outline the geometric principles that make patient positioning critical to diagnostic integrity. Radiographic image formation is governed by principles of projection geometry: structures nearer the image receptor exhibit less magnification; obliquity of the part relative to the beam introduces foreshortening or elongation; and structural superimposition is dictated by the angle of incidence of the central ray [2,8]. These principles mean that small angular deviations in patient or part alignment can produce clinically meaningful distortions.

Three primary axes of positioning error can be identified: (1) Rotation-lateral or axial rotation of the body part about its long axis, producing asymmetric appearance of bilateral structures; (2) Tilt-angulation in the coronal plane, altering the apparent relationship of superior and inferior structures; and (3) Flexion/extension deviations-alterations in the sagittal plane that alter joint space profiles or vertebral alignment. In addition to geometric errors, improper positioning can result in incorrect collimation (partial cutoff of the region of interest), suboptimal respiratory phase (relevant in thoracic and abdominal imaging), and inadequate immobilisation leading to motion blur [9].

The concept of the repeat/reject rate is central to quality assurance in radiographic departments. A repeat is a radiograph that must be re-acquired due to technical deficiency; a reject is a radiograph discarded from clinical use. International benchmarks suggest an acceptable overall repeat rate of below 5%, though many departments, particularly in under-resourced settings, report substantially higher rates [6,10]. Positioning errors consistently emerge as the leading or second-leading cause of repeats in published audits, underscoring their operational and clinical significance.

4. Positioning Errors by Anatomical Region and Modality

4.1 Chest Radiography

The chest radiograph (CXR) is the most frequently performed imaging examination worldwide and arguably the most positioning-sensitive. The posteroanterior (PA) projection requires the patient to stand erect, with the anterior chest wall against the image receptor, shoulders depressed, and hands placed on hips to rotate the scapulae laterally [2]. Respiration is suspended at full inspiration. Failure to achieve any of these criteria produces characteristic artefacts.

Patient rotation is identifiable by asymmetry of the medial clavicular ends relative to the spinous processes. Even minor rotation (5–10 degrees) can falsely increase the apparent width of the mediastinum-a finding that may prompt unnecessary CT aortography to exclude dissection-and can shift the cardiac silhouette to create the appearance of dextrocardia or cardiomegaly [11]. Rotation also alters the relative density of the two hemithoraces, making unilateral lung pathology appear more or less prominent. Dobbins et al. demonstrated that rotation of 5° or more significantly altered automated cardiomegaly detection algorithms, illustrating the downstream implications of even modest positioning errors in AI-assisted radiology [12].

Inadequate inspiration is a highly prevalent positioning error. A technically adequate PA CXR should demonstrate at least 9–10 posterior ribs above the diaphragm. Poor inspiratory effort elevates the diaphragm, basilar lung markings appear crowded, the cardiothoracic ratio increases spuriously, and small pleural effusions may be obscured [11]. In emergency settings, where patients may be unable to cooperate fully, these artefacts are particularly hazardous.

The anteroposterior (AP) supine or semi-erect projection, used in bedside radiography, introduces additional positioning challenges: inherent geometric magnification of anterior structures (particularly the heart and mediastinum), loss of fluid levels, and inability to assess pneumothorax reliably. Awareness of the AP technique's limitations is crucial for interpreting portable CXRs accurately [9].

4.2 Musculoskeletal Radiography

Musculoskeletal (MSK) radiography encompasses the largest number of individual projections and positioning protocols. In spinal imaging, rotational or tilt positioning errors have well-documented consequences. For lumbar spine radiography, pelvic obliquity introduces apparent scoliosis that must be distinguished from structural curvature [13]. The Cobb angle, used to quantify scoliotic deformity, is highly sensitive to patient rotation; errors of 5–10° in patient positioning have been shown to alter Cobb angle measurements by clinically significant margins, potentially altering treatment decisions [14].

In knee radiography, the joint space width is the primary metric for osteoarthritis staging. The Kellgren-Lawrence grading system relies on the apparent medial and lateral compartment heights on the AP standing view. Slight flexion of the knee (as little as 5°) artificially narrows the posterior compartment, producing false-positive findings of significant joint space loss [15]. Conversely, hyperextension overcorrects compartment alignment. The Lyon Schuss view, which standardises knee flexion at 20–30°, was developed specifically to address this positioning variability, yet is not universally adopted.

Shoulder radiography is susceptible to rotation errors that alter the apparent position of the humeral head relative to the glenoid. Internal rotation positions the lesser tuberosity en

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face, while external rotation demonstrates the greater tuberosity in profile. Confusing these rotational states may lead to missed calcific tendinopathy, erroneous assessment of Hill-Sachs lesions, or failure to identify subtle anterior glenohumeral instability [2,3].

Scaphoid fracture detection is among the highest-stakes positioning challenges in the wrist. The dedicated scaphoid series requires ulnar deviation to bring the scaphoid parallel to the film plane; without this, the waist of the scaphoid is foreshortened and non-displaced fractures may be invisible [16]. Given that a missed scaphoid fracture carries a risk of avascular necrosis, positioning precision in this context has direct prognostic implications.

4.3 Mammography

Mammography is one of the most positioning-demanding radiographic examinations, requiring operator skill that directly determines cancer detection rates [17]. The craniocaudal (CC) and mediolateral oblique (MLO) projections each have precise anatomical criteria. In the CC view, nipple projection, symmetric posterior nipple line depth bilaterally, and complete inclusion of the medial breast are required. In the MLO view, the pectoralis major muscle should be visible to the posterior nipple line, the inframammary fold should be open, and the nipple should be in profile.

Studies have consistently demonstrated that inadequate positioning in mammography accounts for a significant proportion of missed breast cancers, particularly in the posterior and axillary tail regions [17,18]. Andersson et al. reported that up to 15% of interval cancers (cancers detected between screening rounds) arose in regions not adequately imaged due to positioning deficiency [18]. The European Guidelines for Quality Assurance in Breast Cancer Screening specify detailed positioning criteria and require radiographer positioning performance to be audited regularly.

4.4 Fluoroscopy and Gastrointestinal Imaging

Fluoroscopic examinations of the gastrointestinal tract-barium swallow, meal, follow-through, and enema-depend on precise patient obliquity and table angulation to profile mucosal surfaces, demonstrate valvulae conniventes, and open the gastroesophageal junction. Incorrect positioning can superimpose loops of bowel, obscure mucosal folds, and create apparent strictures or filling defects [9]. Double-contrast barium enema technique in particular requires coordinated patient rotation through multiple positions to coat the colonic mucosa. Error at any stage may result in missed polyps or carcinomas.

4.5 Computed Tomography (CT)

Although CT is less dependent on patient positioning than plain radiography-the tomographic nature of the examination largely overcomes projectional distortion-positioning errors remain consequential. Patient centring within the CT gantry is critical: off-centre positioning increases both image noise and radiation dose due to the beam hardening and attenuation geometry of the X-ray beam. Literature indicates that off-centring by 4–6 cm can increase effective dose by up to 40% [19]. In CT of the spine, patient tilting introduces gantry angulation errors that compromise the orthogonality of axial reconstructions relative to the disc spaces.

In CT angiography, patient arm positioning affects the accuracy of scout image attenuation measurements used for contrast timing and automated exposure control. Head CT requires the orbitomeatal baseline to be perpendicular to the scanner axis to ensure symmetrical brain imaging and minimise lens dose.

4.6 Magnetic Resonance Imaging (MRI)

Patient positioning in MRI affects coil proximity, magnetic field homogeneity, and gradient linearity-all of which influence signal-to-noise ratio and geometric accuracy. Improper coil placement-for example, placing a surface coil too far from the structure of interest-results in signal dropout. Patient angulation within the bore causes the imaged anatomy to lie outside the optimal gradient linearity zone, introducing geometric distortion at image peripheries [20]. Extremity MRI is particularly prone to positioning-related distortion when the limb is not co-axial with the bore.

Table 1: Common Positioning Errors and Their Diagnostic Consequences in Plain Radiography

Projection / Region	Common Positioning Error	Diagnostic Consequence
Chest PA	Patient rotation, insufficient inspiration	Apparent cardiomegaly, obscured costophrenic angles, vascular redistribution artefacts
Lumbar Spine AP/Lat	Pelvic tilt, oblique positioning	Scoliosis misquantification, disc space distortion, missed spondylolisthesis
Knee AP	Incorrect flexion angle (not 0–5°)	Apparent joint space narrowing, inaccurate osteoarthritis grading
Shoulder AP	Internal/external rotation mismatch	Rotator cuff calcification missed, humeral head subluxation undetected
Cervical Spine Lat	Inadequate C7–T1 visualisation	Lower cervical fractures/dislocations missed
Pelvis AP	Leg rotation, beam centering error	Asymmetric femoral necks, false acetabular depth measurement
Abdomen AP	Inspiration instead of expiration	Gas patterns misinterpreted, diaphragm elevated artefactually
Wrist PA/Lat	Ulnar/radial deviation, wrist pronation	Scaphoid fractures missed, carpal alignment errors
Skull AP/Lat	Head tilt, orbital line misalignment	Suture misidentified as fracture, orbital asymmetry

MSK = musculoskeletal; OA = osteoarthritis; AP = anteroposterior; PA = posteroanterior; Lat = lateral

5. Diagnostic Consequences and Patient Safety Implications

The diagnostic consequences of positioning errors fall into three broad categories: (i) false-positive findings-artefacts that simulate pathology; (ii) false-negative findings-obscuration of genuine pathology; and (iii) measurement errors-distortion of quantitative metrics used for disease staging or treatment response assessment [4,5].

False-positive findings are particularly hazardous because they trigger further investigation-CT, biopsy, endoscopy-each carrying its own procedural risk and cost. A classic example is the apparent mediastinal widening caused by patient rotation on AP CXR in the trauma setting, which may precipitate CT aortography to exclude aortic injury [11]. Similarly, positioning-related pseudo-varus or pseudo-valgus deformity of the knee may initiate an orthopaedic referral pathway for a patient with structurally normal joints [15].

False-negative findings may be more insidious, as missed diagnoses frequently go unrecognised until clinical deterioration occurs. Missed pneumothorax on a supine AP CXR in a ventilated ICU patient is a well-documented example; the dependent distribution of air in the supine position, combined with the limitations of the AP projection, means that pneumothorax may be detected only on the erect PA view or CT [9]. Scaphoid fracture, as discussed above, represents another example where positioning inadequacy can lead to a missed diagnosis with serious long-term consequences.

Beyond direct diagnostic error, improper positioning contributes to increased radiation exposure through the need for repeat examinations. While individual repeat radiographs deliver relatively modest doses, the cumulative population dose from avoidable repeats is not trivial, and repeat examinations in paediatric and pregnant patients raise particular safety concerns [21]. Institutions with high repeat rates face an ethical and regulatory obligation to identify and address systemic positioning deficiencies.

Medicolegal implications also warrant acknowledgment. Radiographs form part of the patient's permanent legal medical record. A poorly positioned radiograph that contributes to a missed diagnosis, or that is rejected and not replaced, creates both a gap in the clinical record and potential liability for the radiographer, radiologist, and institution [4]. Quality assurance programmes that document positioning standards and track performance serve a dual protective function.

Table 2. Summary of Positioning Impact Across Major Imaging Modalities

Modality	Key Positioning Parameter	Effect of Non-Compliance	Reported Error Rate
Plain Radiography (Chest)	Rotation, inspiration level	Cardiothoracic ratio error, missed pneumothorax	Up to 26% repeat rate
Plain Radiography (MSK)	Beam angle, joint flexion	Missed fractures, OA misgrading	10–20% diagnostic discrepancy
Fluoroscopy (GI)	Patient obliquity, table tilt	Mucosal fold obscuration, false stricture	Variable; operator-dependent
CT (Scout/Planning)	Patient centring in gantry	Dose increase up to 40%, beam hardening	Significant in obese patients
MRI	Coil placement, patient alignment	Signal dropout, geometric distortion	Moderate; coil-dependent
Mammography	Breast compression, positioning angle	Missed lesions in posterior breast	10–15% of missed cancers
Dental / OPG	Chin position, Frankfort plane	Distorted mandibular condyles, magnification error	Common in paediatrics

MSK = musculoskeletal; OA = osteoarthritis; CT = computed tomography; MRI = magnetic resonance imaging; GI = gastrointestinal; OPG = orthopantomogram. Error rates are approximate institutional estimates from published audits. Reported error rates vary widely depending on institution, patient population, and methodology.

6. Prevalence of Positioning Errors: Evidence from Reject Analysis Studies

Reject/repeat analysis is the primary method by which radiology departments quantify and categorise the causes of technically deficient examinations. Published studies consistently identify positioning as either the leading or second-leading cause of rejects, after exposure factor errors [6,7,22].

A multi-institutional study by Mooney and Thomas involving 14 hospitals in the United Kingdom found that positioning accounted for 37–44% of all rejected radiographs, with the highest positioning rejection rates observed for chest and spine examinations [22]. A systematic review by Osei and Benkendorf encompassing studies from diverse healthcare contexts found weighted mean positioning-related rejection rates of 26.4% across all projections, with significant variability between departments and nations [6]. In low-and middle-income country settings, positioning error rates are generally higher, reflecting differences in training infrastructure, staff-to-workload ratios, and equipment quality [7].

Paediatric radiography is a domain of particular concern, where patient cooperation is inherently limited and the consequences of repeat exposure are magnified by greater radiosensitivity. Published paediatric rejection rates attributable to motion and positioning combined have been reported as high as 30–40% in some series [21]. The introduction of dedicated paediatric positioning aids and age-appropriate patient communication protocols has been shown to reduce these rates substantially. It is important to note that repeat/reject analysis captures only those positioning errors severe enough to necessitate repeat acquisition. A larger number of suboptimal but accepted radiographs are used despite positioning errors and are difficult to quantify. These borderline-quality examinations may contribute to the diagnostic error burden in ways that standard quality audits do not capture.

7. Contributing Factors to Positioning Errors

Positioning errors are multifactorial in origin, arising from the interplay of technologist-, patient-, and systems-level factors. At the technologist level, inadequate initial training, insufficient supervised practice hours, knowledge decay following qualification, fatigue, and high workload have all been implicated [4,5]. Junior radiographers and student radiographers have higher error rates than experienced practitioners, consistent with a competency accumulation model [7]. Patient-related factors include body habitus (obesity significantly complicates positioning for CT gantry centring, mammography compression, and MRI coil placement), age-related immobility or contracture, pain and reduced range of motion, neurological impairment affecting cooperation, and language barriers that limit understanding of positioning instructions [9,23]. Emergency patients are a particularly high-risk group, as clinical urgency may preclude optimal positioning.

Systemic and environmental factors include inadequate staffing, time pressure from high patient throughput, equipment design limitations, poor signage or language accessibility for patient instructions, and institutional cultures that do not prioritise or monitor image quality [4,24]. Radiography performed in non-dedicated settings-bedside, operating theatre, intensive care unit-is inherently more positioning-limited than examination-room-based imaging.

8. Strategies for Reducing Positioning Errors

8.1 Radiographer Education and Training

Competency-based education programmes that incorporate simulation, direct observation, and formative feedback are the cornerstone of positioning error reduction [4,24]. Training on anatomical mannequins and positioning phantoms allows skill development without patient radiation exposure. Structured clinical placements with direct supervisor assessment of positioning performance have been shown to be more effective than passive observation. Continuing professional development requirements that include positioning refreshers and case-based learning maintain competency post-qualification.

8.2 Standardised Protocols and Checklists

Institution-specific positioning protocol booklets, supplemented by laminated projection-specific checklists at each imaging station, provide readily accessible reference standards and prompt systematic adherence to positioning criteria [3]. Quality management systems that require radiographers to document positioning compliance contribute to accountability. Protocol standardisation also enables meaningful inter-departmental benchmarking.

8.3 Technology-Assisted Positioning

Technological innovations offer promising adjuncts to human skill. Automated positioning assistance systems — including laser alignment guides, motorised table and Bucky movements, and gantry auto-centring-reduce the cognitive and motor demands of positioning [19,25]. AI-based image quality assessment systems can automatically detect positioning errors such as rotation, inadequate inspiration, and incomplete anatomical inclusion in chest radiographs, providing immediate feedback to radiographers and reducing repeat examinations [12,25,26]. Integration of these tools into routine workflow has the potential to reduce positioning-related repeats substantially.

8.4 Quality Assurance and Audit

Regular reject/repeat analysis, performed at least monthly and discussed at departmental quality improvement meetings, creates a continuous feedback loop that identifies positioning problem areas and tracks the effectiveness of interventions [6,10,22]. Peer review of borderline-quality radiographs, dose monitoring, and radiologist feedback to radiographers on positioning adequacy are supplementary quality mechanisms. External benchmarking against published standards motivates performance improvement.

8.5 Patient-Centred Communication

Standardised patient instruction protocols-including clear breath-hold commands, visual aids, and provision of interpreter services for non-English-speaking patients-reduce the contribution of patient non-compliance to positioning error [23]. For paediatric patients, age-appropriate immobilisation strategies and play-based preparation reduce movement artefact. Pre-procedural patient preparation, including assessment of mobility and pain, allows radiographers to anticipate positioning challenges and adapt technique accordingly.

Table 3: Evidence-Based Strategies for Reducing Positioning Errors in Radiographic Practice

Level	Strategy	Expected Outcome
Technologist Training	Structured competency-based positioning education; simulation mannequins; direct supervisor assessment	Reduced repeat rates, improved image quality
Protocol Standardisation	Institution-specific SOP booklets; anatomical landmark checklists for each projection	Consistency across shifts and staff levels
Technology Integration	Automated positioning aids (laser alignment, motorised tables); AI-based real-time feedback systems	Objective error detection before exposure
Quality Assurance	Repeat/reject analysis audits (monthly); dose tracking; peer review of borderline images	Continuous improvement loop; medicolegal protection
Patient Communication	Plain-language instructions; language interpreter access; clear breath-hold commands	Reduced motion artefact; improved cooperation
Continuing Education	Workshops, case-based learning, CPD credits for radiographers on positioning updates	Skill maintenance and awareness of best practice

SOP = standard operating procedure; AI = artificial intelligence; CPD = continuing professional development.

9. Emerging Technologies: Artificial Intelligence in Positioning Quality Control

Artificial intelligence and machine learning have entered the quality assurance domain of radiographic imaging with growing momentum. Deep learning algorithms trained on large datasets of radiographs can automatically detect positioning errors such as rotation, inadequate inspiration, and incomplete anatomical inclusion in chest radiographs, with several studies reporting excellent diagnostic performance and area-under-the-curve values exceeding 0.90 [12,25,26]. These systems can be embedded into the image acquisition workflow to provide real-time alerts before image submission.

Beyond binary quality assessment, AI tools are being developed to quantify positioning deviation-for example, measuring rotation angle in degrees or estimating the degree of flexion deviation in joint radiography-and to recommend corrective patient adjustments. Such quantitative feedback is more actionable than categorical pass/fail judgements. However, clinical implementation requires attention to false-positive alert rates, integration with existing RIS/PACS workflows, and appropriate clinician and radiographer education on system capabilities and limitations [25].

Natural language processing (NLP) systems that extract positioning comments from radiologist reports offer another avenue for systematic quality data collection, enabling departments to identify patterns of positioning failure without the resource burden of manual reject analysis. The convergence of AI-based positioning feedback, automated patient instruction systems, and real-time dose monitoring represents a future-state imaging department in which positioning quality is continuously optimised rather than retrospectively audited.

10. Discussion

This review confirms that improper patient positioning represents a significant, multifaceted, and underappreciated source of diagnostic error in radiographic imaging. The evidence base, drawn from reject analysis studies, clinical outcome data, and positioning accuracy research, converges on a consistent picture: Positioning errors are common, clinically important, preventable, and often under-prioritised. Several themes emerge from the synthesis. First, chest radiography and musculoskeletal imaging bear the highest burden of positioning-related diagnostic compromise, partly because of their volumetric dominance and partly because of the clinical significance of the anatomical measurements they inform. Second, the consequences of positioning error are not confined to image quality degradation — they include false-positive findings that generate unnecessary investigation, false-negative findings that delay diagnosis, excess radiation dose from repeats, and medicolegal risk. Third, positioning error rates are strongly modifiable through targeted intervention at the educational and systems levels.

The role of the radiographer as the principal gatekeeper of image quality places professional and ethical obligations on radiography education programmes, regulatory bodies, and employing institutions to ensure that positioning competency standards are set, assessed, and maintained. Radiographers are not mere button-pressers; they are clinical professionals whose technical decisions directly influence patient outcomes. Framing positioning quality as a patient safety issue-analogous to surgical technique or medication prescription accuracy-is warranted and would elevate its priority in resource allocation and performance management.

The application of AI to positioning quality control is promising but nascent. Current evidence comes predominantly from single-centre, retrospective studies with limited generalisability. Prospective, multi-centre evaluation of AI positioning tools in routine clinical workflows, with patient outcome data as primary endpoints rather than technical image quality metrics, is needed before widespread recommendation. Integration with human skill rather than replacement of it should be the design and deployment philosophy.

Limitations of this review include the predominantly descriptive nature of the evidence base-randomised controlled trials of positioning interventions are rare and methodologically challenging-and significant heterogeneity in how positioning error and diagnostic consequence are defined and measured across studies. Many studies rely on reject rate as a proxy for diagnostic impact, which underestimates the true burden by excluding accepted-but-suboptimal images. Future research should prioritise patient outcome measures and standardised definitions of positioning adequacy to enable more rigorous meta-analysis.

11. Conclusion

Patient positioning is an essential determinant of diagnostic image quality in radiographic imaging, with deviations from accepted criteria producing a spectrum of diagnostic errors ranging from measurement inaccuracies to clinically significant missed diagnoses. Positioning-related repeat rates of up to 26% represent a preventable patient safety burden. The evidence supports a multi-pronged prevention strategy encompassing competency-based radiographer education, standardised institutional protocols, robust quality assurance audit cycles, technology-assisted positioning aids, and effective patient communication. Artificial intelligence offers emerging potential as a real-time quality feedback tool, though robust clinical evidence is still accruing. Radiography education bodies and imaging departments should recognise patient positioning competency as a core professional standard and invest accordingly in its development and maintenance. Closing the gap between positioning standards and clinical practice remains a major opportunity to improve diagnostic quality and patient safety.

Declarations

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