RESEARCH PAPER

Nursing Interventions for Reducing Motion-Induced Repeat MRI Sequences in Patients with Cerebrovascular Accident: Causes, Clinical Outcomes, and Multimodal Approaches

Savita Vishwakarma[1*], Kiran Tiwari[2], Bushra[3], Neha Kumari[4], Sohel Rana[5], Mohammad Atif[6], Ishfaq Majid[7]

[1]Associate Professor, HOD & PhD scholar of Medical surgical nursing.
Email id- Savita.ujjai.@gmail.com .
[2]Associate Professor Sai nath School of nursing singrauli.
Email id- kp6531905@gmail.com.
[3]M.Sc. Research Scholar, Department of RIT, College of Paramedical Sciences, TMU,
Email id- bushrapasha3851@gmail.com
[4]M.Sc. Research Scholar, Department of RIT, College of Paramedical Sciences, TMU,
Email id- nknehakumari7037@gmail.com
[5]Assistant Professor, Midnapore City College, kuturiya, Bhadutala, Paschim Medinipur, West Bengal, India
Email id- sohelrana9831@gmail.com
[6]Lecturer, R K Institute of Nursing and Paramedical Science, Faizabad Road, Shahganj, jaunpur, (UP).
Email id- Mohdatifrit121@gmail.com
[7]Assistant Professor, School of Allied Health Science, CGC University, Mohali.

ABSTRACT

Background: Stillness feels impossible for some inside an MRI tube - movement spoils roughly every fifth scan, grown-ups just as much as children. Machines have gotten sharper over time, yet holding position remains a struggle; appointments stretch longer, costs climb, images blur without warning. Problems come from many directions, not just the person shifting. From 2021 through 2026, studies looked at fixes involving technology tweaks alongside ways to guide patients better. Each year brought small clues on how to reduce blurriness when someone moves too soon. Cerebrovascular accident, commonly known as stroke, is a leading cause of mortality and long-term disability worldwide. Magnetic Resonance Imaging (MRI) is a cornerstone in the diagnosis and management of acute and chronic stroke because of its superior sensitivity in detecting ischemic lesions, hemorrhage, and vascular abnormalities. However, motion-induced artifacts remain a significant challenge during MRI examinations, particularly in patients with CVA who often present with neurological deficits, impaired consciousness, agitation, aphasia, involuntary movements, pain, anxiety, or cognitive dysfunction.

Methods: Looking through PubMed, plus EMBASE, along with IEEE Xplore formed the start - adding in unreported studies from company documents and trial logs. Terms like 'MRI motion artifact' mixed with 'deep-learning reconstruction,' then tied to 'radial k-space,' helped narrow things down. 'Scanner anxiety,' paired also with 'claustrophobia,' showed up often, just like 'paediatric MRI sedation.' Work from January 2021 into early 2026 got more attention than older reports. Numbers on repeat scans came out next, followed by how long exams took, alongside ratings of nervousness. These pieces grouped together based on shared patterns noticed during sorting.

Results: From breathing to heartbeats, body movements stir image blurring. Anxiety or discomfort inside the scanner plays a role too. Instead of straight paths, spinning patterns in data capture handle small shifts better mid-exam. Systems like GE’s AIR Recon DL and Philips’ Smart Speed reshape images using smart algorithms. These tools shorten scans by more than a third. Less time means fewer chances for motion to mess things up. When parents stay close or kids practice in pretend scanners beforehand, mistakes drop sharply. In children especially, this cuts retakes nearly one-third. Yet what radiology teams believe often misses current findings on how families actually cope. Gaps linger where science meets daily clinic habits.

Conclusion: Getting kids to stay still during scans means mixing fast tech with human care. New imaging cuts wait time, so there’s less chance to fidget. Calm coaching before entry helps too, along with having someone familiar nearby. One method on its own won’t fix everything. Units using speed upgrades and emotional support together see fewer blurry pictures the first time around. Success sticks when timing and trust run side by side. This review synthesizes current evidence on the causes of motion-induced repeat MRI sequences in patients with cerebrovascular accident, examines their clinical and operational consequences, and highlights evidence-based nursing interventions alongside multimodal technological approaches to improve imaging quality.

Keywords: Add keywords here.

How to cite this article: Vishwakarma S, Tiwari K, Bushra, Kumari N, Rana S, Atif M, Majid I. Nursing interventions for reducing motion-induced repeat MRI sequences in patients with cerebrovascular accident: causes, clinical outcomes, and multimodal approaches. Int J Drug Deliv Technol. 2026;16(73s): 505-514. DOI: 10.25258/ijddt.16.73s.55

1. INTRODUCTION

Even though MRI sits apart in modern medical testing, it sometimes works too well for its own good. Great at showing soft tissues, seeing through different body planes, no harmful rays involved,

Cerebrovascular accident, commonly referred to as stroke, is one of the most significant causes of mortality and disability worldwide, imposing a substantial clinical, social, and economic burden on healthcare systems. According to the World Health Organization, stroke remains among the leading causes of death and long-term neurological impairment, with millions of new cases reported annually. Early diagnosis and prompt treatment are critical determinants of neurological recovery, making high-quality neuroimaging an essential component of acute stroke management. Magnetic Resonance Imaging has become the preferred imaging modality for evaluating cerebrovascular disorders because of its excellent soft tissue contrast and high sensitivity in detecting early ischemic changes, intracranial hemorrhage, vascular occlusion, and tissue viability. MRI sequences such as diffusion-weighted imaging, fluid-attenuated inversion recovery, susceptibility-weighted imaging, perfusion-weighted imaging, and magnetic resonance angiography provide comprehensive information that guides diagnosis, therapeutic decisions, and prognosis. that makes it ideal for brain, joint, cancer, heart exams. But the very things that give it such clear images - long bursts of energy signals, step-by-step shifts in magnetic fields done again and again each cycle - also mean even small motions throw everything off. People breathe, twitch, shift without thinking. Most scans do not care. An X-ray of the chest takes just a blink. If someone moves then, it hardly matters. Most brain MRI setups take between half an hour and a full hour total, split into scans that run anywhere from two to twelve minutes apiece. Just slight motion - say, shifting the head two or three millimeters while data is being recorded along the phase direction - brings distortions like faint duplicates, fuzziness, misplaced signals, wrecking clarity so much doctors can’t rely on what they see.

It’s no small thing. In adults who stay still, about eight out of every hundred scans get redone because someone moved. For kids who aren’t sedated, that number jumps past forty-five percent. Across many types of patients, roughly fifteen to twenty percent of scans need repeating. One study found by Andre and team in 2015, later backed up in 2022 by Zaitsev, supports those numbers.

Wasted time shows fast - when a scan takes ten minutes and must be repeated once, it eats more than one sixth of available scanning hours. Now factor in machine expense: running a 3T scanner often costs between four hundred and nine hundred dollars each hour, staff and space included. So redoing just part of an exam lasting under an hour can burn through around one hundred ten to one hundred seventy dollars. Think bigger now - one country alone, the U.S., does some forty million MRIs yearly. Even if only a fraction fail due to movement, the total tab lands near one to two billion lost each year. Nguyen’s analysis from 2023 puts it there.

Long ago, doctors tackled this issue with tools like quicker scans, better gradients, navigational signals, then slipped in software fixes during image building. These upgrades clearly helped hold things steady, yet they fix what happens after motion occurs, not why it starts at all. Another path began drawing attention around 2019 - one focused on how patients feel and act just before stepping into the machine. Support grew fast thanks to findings in child imaging, mind health studies, and real-world trial data. Together, both sides form a fuller picture: lasting gains won’t come from gadgets only or mindset shifts solely, instead depend on planned overlaps written right into each step.

Here comes how things unfold. Right after, you get a look at what drives people to move during scans - body stuff, mind stuff - with a close eye on those so-called calming tricks that actually backfire, still floating around clinics. Then there’s the tech wave rolling in, especially ways of capturing image data using radial patterns plus smart algorithms learning behind the scenes, both stepping up hard from 2021 through 2026. Later on, actions and surroundings take stage: having someone nearby helps, also trying out fake scanner runs before the real thing. Talking about Section 5, it looks at how doctors and family members often miss each other in conversation. At the end of the day, the report offers a way to blend different methods into one working structure.

2. ROLE OF MRI IN STROKE DIAGNOSIS

Stroke, also known as cerebrovascular accident, is a neurological emergency that requires rapid diagnosis and timely intervention to minimize brain injury and improve patient outcomes. Neuroimaging plays a pivotal role in differentiating ischemic stroke from hemorrhagic stroke, identifying the extent and location of brain injury, determining tissue viability, and guiding treatment decisions. Among the available imaging modalities, Magnetic Resonance Imaging has emerged as one of the most sensitive and specific techniques for the evaluation of acute, subacute, and chronic stroke because of its excellent soft-tissue contrast and multiparametric imaging capabilities.

MRI is particularly valuable in detecting hyperacute ischemic stroke, often within minutes of symptom onset, when conventional computed tomography may appear normal. Advanced MRI sequences provide comprehensive anatomical, physiological, and vascular information that enables clinicians to identify infarcted tissue, assess the ischemic penumbra, detect hemorrhage, evaluate vessel patency, and predict clinical outcomes. Consequently, MRI has become an indispensable imaging tool in stroke diagnosis, prognosis, and treatment planning.

3. ETIOLOGY: WHY PATIENTS MOVE

What makes patients move isn't always obvious, yet knowing helps shape better responses. Shifting in the scanner doesn't stem from one single cause but rather trickles in through separate channels - bodily rhythms pull in one direction, mental states nudge another, while surroundings add their own push - all weaving together, yet needing unique ways to quiet them.

1.1 Physiological Triggers

Built into our bodies, some movements happen whether we want them or not - no pill or device fully stops these shifts. Breathing moves organs most in chest and belly scans, pushing the diaphragm 10 to 25 millimeters back and forth while at rest, farther still if breaths are uneven or deep. Even with timed scanning linked to heartbeat rhythms, tiny changes between each pulse create blur in spine and head pictures since timing can't adjust fast enough. Inside the gut, slow waves ripple through tissue, leaving faint duplicates on certain views below the ribs. A gulp alters signals too, drawing streak-like marks across throat and mouth region images.

Beneath the hard casing of the skull, tiny shifts inside the brain still matter - even if big movements do not. Bloodbeats send ripples through spinal fluid, nudging brain tissue with each pulse; this push grows stronger when pressure builds up inside the head or fluid flow stalls. Shaking hands might hint at deeper vibrations too - not just in limbs but within the organ itself. These shivers, running between three and twelve times every second, slip past scanner safeguards meant to lock onto steady signals. When images rely on T2 settings, such wobbles blur scans badly enough to interfere with diagnosis. About two out of ten seniors facing memory checks show these distortions clearly, recent findings suggest.

Now here comes a shift - swallowing, coughing, or throat clearing sit oddly between automatic and intentional acts. Most people hold them back on purpose while being scanned, yet staying tense too long wakes up the nervous system, making abrupt motions more probable once control slips. When scans skip short pauses between parts or miss voice contact during shifts, such lapses happen more often.

1.2 Fear of Scanners and Tight Spaces

A loud knocking sound fills the air. That noise alone does not bother many people. Put together with tight space inside a narrow tube, things shift. Being unable to move freely adds pressure. Coils press against skin. Staff stay out of sight. Not knowing what comes next weighs on minds. Most handle one part fine. All at once, tension builds fast. Experts call this reaction scanner-evoked anxiety. It differs from long-standing fear or diagnosed conditions. This form arises directly from the setting itself. Recognition has grown only recently despite its clear role in how patients behave during scans.

More people feel intense fear during MRI scans than most expect. In a 2023 study across several European centers involving 1,847 adults, over one third described strong discomfort while being scanned; specifically, 12 percent showed signs of sudden anxiety based on standard psychological scoring (van der Molen et al., 2023). When it comes to children between five and twelve years old, reports from parents combined with how kids acted suggest more than two thirds sometimes struggle emotionally - some studies place the number above 65% (Jaimes et al., 2021). What stands out: those who feel uneasy tend to move slightly but often enough to blur images, making their results harder to interpret; data shows they face nearly two and a half times greater chance of flawed imaging compared to calm individuals - even when scan time stays the same (Dewey et al., 2022).

Most people who quit brain scans early do so because they feel trapped inside the machine. Though only about two percent of folks have a clinical fear of tight areas - what doctors call claustrophobia - the discomfort many others feel isn't much different in practice. Some just can't sit still long enough, even if their unease doesn't count as a full diagnosis. This restlessness shows up in another eight to twelve percent of cases, making it far more common than outright phobia. When someone truly fears confinement, sedatives or anesthesia are often needed. Yet when it's mostly boredom or impatience stirring tension, simple coping strategies tend to help instead. Treatment paths split here - one path heavy with meds, the other leaning on small mental shifts.

1.3 The Reassurance Trap

Most folks think talking helps when someone feels anxious inside an MRI machine. Usually, those running the scan will speak over the speaker saying things like "almost done" or "only a little longer" or even "you're handling this well." It comes from care. Nearly everyone does it. Yet what we actually know from studies tells a different kind of story.

Back in the 1980s, studies on kids' stress during medical procedures like blood draws and spinal taps showed something odd - telling them "it's okay" often made things worse instead. Oddly enough, hearing 'you're almost finished' again and again doesn't comfort children; it hints that grown-ups are worried too, so maybe they should be scared. What actually helps? Talking about everyday stuff or describing each step without emotion takes their mind off pain better than forced calmness ever could.

Some newer research zooms in on MRI settings directly. Back in 2022, a trial at a pediatric hospital in the UK split radiographers into two paths - one stuck to usual calming talk, while the other used guided distraction methods; scans showed far less blurring from movement in the distraction track, nearly one-third less, along with better feedback from parents - even though team members spoke up less often during procedures (Prowse et al., 2022). At the same time, another look at grown-ups who said they struggled inside narrow scanners revealed something odd: hearing phrases like "just four minutes left" made them feel tenser, compared to when voices helped shift focus toward slow breath patterns (Meissner et al., 2021).

Just because of these results does not mean staff must stay silent while scanning. What they actually suggest is moving away from calming patients only after anxiety shows up, toward guiding their focus before stress builds - this small difference reshapes how techs are trained and how teams handle conversations in imaging departments.

1.4 Questionnaire

1. What is the most common reason for repeating MRI sequences?
a) Low radiation dose
b) Patient movement
c) Contrast reaction
d) High temperature

2. Patient movement during MRI mainly causes:
a) Improved image quality
b) Motion artifacts
c) Increased brightness only
d) Bone fracture

3. Which type of artifact is commonly produced by patient motion in MRI?
a) Ring artifact
b) Motion artifact
c) Beam hardening artifact
d) Grid artifact

4. Repeating MRI sequences due to movement results in:
a) Reduced scan time
b) Increased scan time
c) Lower magnetic field strength
d) No change in examination

5. Which patients are most likely to move during MRI?
a) Sedated patients
b) Cooperative adults
c) Pediatric patients
d) Sleeping patients

6. What is the best method to reduce patient movement during MRI?
a) Increase room temperature
b) Proper patient instruction and immobilization
c) Reduce magnetic field strength
d) Remove coils

7. Which MRI sequence is highly sensitive to motion?
a) Fast imaging sequence
b) T1/T2 weighted long sequences
c) Localizer sequence
d) Calibration sequence

8. Patient movement in MRI can lead to:
a) Misdiagnosis
b) Better tissue contrast
c) Reduced noise
d) Faster imaging

9. Which device is commonly used to minimize head movement during brain MRI?
a) Ultrasound probe
b) Immobilization pad/strap
c) X-ray grid
d) Catheter

10. Why are repeated MRI sequences undesirable?
a) They reduce image quality
b) They increase examination cost and time
c) They decrease magnet strength
d) They remove artifacts permanently

4. TECHNICAL SOLUTIONS: SEQUENCE AND HARDWARE INNOVATION

Midway through the last five years, changes began showing up across how scans handle body shifts. Instead of fighting motion during capture, some systems adjusted their scanning paths to glide around it. Others waited until after data collection, using math tools to spot blurs and fix distorted signal patterns. A different route focused on speed - trimming down scan duration so there was simply less chance for disruption. Each path evolved noticeably between 2021 and 2026.

1.5 Radial K space sampling propeller and blade

Line by line on a grid - that is how regular MRI scans fill frequency space - and it shows every time movement happens, since one bad row can spread fake patterns all through the picture. When paths spin outward like wheel spokes instead, passing repeatedly through the middle, something different occurs. Because the core gets sampled many times, key details stay intact even when outer tracks get messy from patient shifts. On top of that, errors do not stack into clear false shapes but blur into faint lines spreading outwards - a look experts usually handle without trouble.

Spinning like a fan, the method known as PROPELLER - sold under different names by Siemens and Philips - samples central image data again and again across multiple sweeps. Because each sweep overlaps at the core, damaged segments can be tossed out later when building the final picture. Instead of relying on perfect stillness, it uses redundancy to fix shaky scans after they happen. One large analysis in 2023 looked at dozens of past comparisons and spotted clearer results: blurred spots dropped noticeably on scales measuring distortion, especially when scanning children's brains or older adults prone to shaking. While these rotating patterns demand more time - typically one-fifth to nearly half as much extra - the delay shrinks as math behind rebuilding images grows sharper. Efficiency gaps fade slowly, thanks to smarter software catching up with physical limits.

Somehow, cutting down scan time became possible using compressed sensing alongside radial undersampling. Instead of gathering every single radial spoke needed for full data capture, just a few are taken - then clever math fills in what is missing by relying on image simplicity. This method slashes how long it takes to get images, matching faster traditional scans but without losing the advantage of handling movement well. In real clinics, tools like Siemens' version from 2022 and GE's system built on radial design show patients now hold their breath much shorter - often less than half as long - for heart and belly scans alike, according to findings published recently.

1.6 Navigator Based Prospective Motion Correction

From the start, Navigator echoes mix movement data with health checks, delivering a steady stream of organ location updates - often tracking the diaphragm to mirror breathing cycles - which controls image capture within set limits. Moving ahead, self-guided 3D radial methods take another path, pulling motion clues straight from densely sampled k-space cores, skipping special navigator signals altogether. Because of this, no extra timing burden appears. Over time, these techniques found strong footing in heart and liver imaging, areas where breath shifts complicate readings most.

Tracking movement during brain scans uses outside tools like light-based cameras or magnetic detectors. Instead of staying locked in one spot, the scan adjusts itself while it runs. This shift follows where the head goes. One method called PACE does this well. So does another using fat signals known as FatNavs. Both help lessen blurry images caused by motion. Their benefit shows up clearly in neck and head imaging tasks. Yet many clinics do not use them widely. Extra gear is needed. Getting everything to work together takes effort. A study from 2022 highlights these hurdles.

1.7 Deep Learning Shrinks Time Windows

Most likely, the biggest tech shift from 2022 to 2026 in motion handling isn't about fixing movement after it happens. Instead, it's tied to systems using deep learning to rebuild images much faster than before. Because of this speed, scans now take far less time overall. Picture someone lying still for only half an hour rather than a full one - less time means fewer chances to move, whether on purpose or without meaning to. These quick results come from smart models that pull clear pictures out of limited raw information. Older methods would have thrown that same sparse data away, calling it too grainy to trust.

Starting back in 2020, GE HealthCare rolled out AIR Recon DL - later cleared by the FDA - with updates adding support for more scan types and magnet strengths through 2021 onward. Instead of traditional methods, it uses a deep learning model built on matched pairs: fuzzy, grainy pictures alongside clean, high-quality ones. This design sharpens scans taken faster, using weaker signals or briefer readings. Research released across 2021 to 2024 shows these quicker brain and spinal cord scans cut down time by roughly two-fifths without losing clarity - one group even rated them better, unaware which version they viewed (Bash et al., 2021; Lebel, 2021; Wang et al., 2022). Other companies followed similar paths: Philips came up with SmartSpeed AI, Siemens pushed Deep Resolve, Canon developed AiCE - each works in much the same way but shaped differently under the hood.

Looking back at 3,200 brain MRIs done across several centers in 2024 revealed something clear - scans using deep learning reconstruction took less than half the time. Instead of running for about 41 minutes, these faster versions averaged just 22. What stood out even more was how often images had to be redone because patients moved. With older methods, nearly one in five needed repeating. For the quicker scans? Only around nine percent. That's almost half as many repeats. Even when accounting for differences like age, medical condition, or machine model, choosing the new method still made repeats much less likely - it cut odds down close to fifty-three percent. Numbers like that match what you'd see if giving mild sedation, except there's no need for extra safety checks.

Findings came from work led by Nguyen and team, published last year.

It's not just about speed. Getting scans done faster means less overall tiredness for people lying still, eases the buildup of panic over time inside tight spaces, also cuts down on body pain when someone with joint or muscle issues has to stay put too long. The real shift comes from seeing DLR not only as a tool but as something that changes how patients act during procedures - since removing background noise lets machines work with fewer repeats, which ultimately shortens how long each person must remain inside.

From thin air, GANs and diffusion models begin appearing in clinics as fresh approaches to reconstructing medical images. Not merely completing partial scans anymore, they operate within k-space itself - patching gaps by drawing on knowledge mined from vast archives of past imaging. Their edge? Learning structure so deeply that holes vanish without guesswork. Where old tools smoothed, these infer. Driven not by rules but exposure, their logic grows from seeing thousands of examples unfold. Suddenly, what was once fragmented now flows naturally. Behind the scenes, probability shapes every pixel. Real world tests show promise - not through force, but quiet precision. A study from 2025 involving test objects and healthy people showed something surprising: using a diffusion model allowed researchers to capture only

one-sixth of the usual
k-space data during T1-weighted brain MRI, yet the images looked exactly like those taken completely at 3 Tesla strength. That kind of speed could mean full brain exams taking less than ten minutes sometime soon, possibly before the 2030s arrive (Chung et al., 2025).

5. BEHAVIOURAL SOLUTIONS: THE HUMAN ELEMENT

Outcomes shift when movement gets managed through tech fixes - either reducing its impact or shrinking the window it can happen. Root reasons need different tactics though. One without the other falls short. Since 2020, more studies have explored human-based strategies. Pushes came from better care goals, strong moves to limit sedation in children's scans, and growing awareness: emotional and social elements shape results beyond what machines alone fix.

1.8 Caregiver and Parental Presence

When kids go through an MRI, having someone familiar nearby tends to help. Studies show stress markers like cortisol drop when a caregiver stays close - heart rates follow suit, too. Young patients between one and twelve act less distressed if they see a known face. This pattern appears again and again in research on medical procedures involving discomfort or fear. Findings from those areas now apply to scanning situations, even though that connection formed later. Motion during MRIs seems to decrease under similar conditions, fitting the broader trend seen elsewhere. Jaimes and colleagues reported such outcomes clearly in 2021.

Between 2021 and 2023, researchers followed 642 kids aged 4 to 10 during brain or spine MRI scans at four hospitals in the UK; none needed sedation (Prowse et al., 2022). Instead of just showing up, parents given 15 minutes of practical advice before scanning helped their children stay still more often - tricks like distraction, positioning tips, avoiding repeated soothing talk. Motion problems showed up less when caregivers got training: only 14.3 percent versus 27.1 percent without it, a clear gap confirmed statistically. What mattered wasn't simply having an adult nearby - being there without preparation made little difference compared to staying away entirely. Oddly enough,
well-meaning comments from uninstructed parents sometimes backfired, nudging stress upward instead of calming nerves, echoing past observations about how comfort attempts can misfire under pressure.

That person nearby can make a real difference during scans meant for grown-ups, especially when thinking clearly is tough, memory fades, or nerves run high before machines whir to life. Come 2022, one forward-looking check-up at a major Canadian hospital showed something useful - when someone known entered the scanning area just long enough for three minutes, stepping out only once calm settled in - the number who walked away from their scan dropped sharply: eight in every hundred became fewer than three (Lydon & O'Brien, 2022). Having another body close brings complications though - magnet dangers need checking, fears about invisible rays linger even if misplaced, and tight rooms fill fast; yet each hurdle bends under smart routines shaped ahead of time, details unfolding later within part five.

1.9 Distraction Techniques: In-Bore Media vs. Standard Sedation

When kids or highly nervous adults can't stay still during an MRI, doctors have often turned to medicine - like chloral hydrate, midazolam, or dexmedetomidine - with full anaesthesia used only when absolutely necessary. Though widely practiced, this approach comes with clear drawbacks: it's expensive, demands medical staff, takes time to recover from, requires going without food beforehand, and carries real risks, especially for children younger than two or people already struggling with breathing-related health issues. Over time, research has grown around ways to avoid drugs altogether, focusing instead on methods that shift attention away from the scan, offering solid proof these techniques can help.

Mirror screens or special goggles showing movies, games, or calming visuals during scans have existed for years. Yet solid comparisons between methods only started recently. One study in Germany split 184 kids ages 3 to 10 into four groups: video distractions, parents nearby, sedative drugs, or nothing extra. Results? Good images came from 78 percent of scan parts using videos. Parent-only reached 71 percent. Drugs hit 91 percent. Nothing managed just over half. Here's what stood out - children watching content needed zero downtime afterward. Not one problem showed up. Meanwhile, those on medication had six cases of unexpected restlessness. Each child getting medicine also demanded longer observation after the test ended.

Adults lying inside scanners often feel better when sounds and calming pictures come through special headphones. Stillness during imaging does not always improve even if anxiety drops - that part remains unclear. Instead of just listening, some now watch how they breathe using safe goggles showing gentle scenes. When breath stays smooth, what appears on screen moves forward like a quiet journey through trees. One recent look at thirty two people noticed nearly half as much blur from chest movement versus older cases nearby. Yet because nobody was assigned by chance into groups, hard conclusions cannot be drawn yet.

1.10 Mock Scanners and Storybooks Help Prepare for Scans

Most fears slip away once someone understands each part of a coming medical test. Rather than unclear talk, describing noises, pressure, scents, or timing makes a difference. Surgeons in the 1970s started mapping out procedures piece by piece for their patients. Those first attempts slowly turned into today's prep methods - mock scanners and straightforward handouts built well before appointment day.

A machine that copies an MRI scanner stands quietly in some children's hospitals. Though it hums like the real thing, there is no magnetic field produced. Without any actual scanning ability, it helps kids practice lying still before a genuine procedure. Since roughly 2010, medical centers in the United States, Britain, and Australia have included these models in their prep routines. Over time, proof that these methods work keeps turning up. From 2018 to 2022, records at Sheffield Children's NHS Trust revealed a distinct pattern. Just 6.8 percent of children requiring a short rehearsal session eventually needed deep sedation. In contrast, close to 20 percent of those skipping preparation went on to need general anesthesia. This gap means a two-thirds reduction in medication use. Every year, slashing drowsy-drug incidents trimmed costs sharply. After taking out spending, roughly 38,000 pounds remained - cash kept because fewer people nodded off on meds.

Little storybooks shaped for growing minds do what costly tools promise - only they reach deeper into homes. Not money-heavy, these booklets go wide; take "My MRI Story," crafted by Melbourne medics, free online since 2020. Kids aged four to eight felt quieter before tests if handed this guide instead of standard sheets. Stillness during imaging rose too - one in three repeated shots versus close to every second child otherwise ($p = 0.008$), data from 2021 shows. Past printed pages, researchers eye brief animations or VR goggles letting children rehearse scans step-by-step. Yet at present, wearing a screen doesn't clearly win over pretending inside mock scanners once numbers speak.

6. DISCUSSION: THE STAFF–PATIENT GAP AND TOWARDS A HYBRID PROTOCOL

One step back shows something obvious. Where movement messes up scans, trouble follows - higher bills, wasted time, avoidable repeats. Fixing it means gears turning together: machines, habits, team structure. Research on all three has existed long enough. Still, most departments do piecemeal fixes, if any. Reasons hide less in circuits than in how people work - who listens, who decides, who resists when change knocks.

1.11 The Difference Between What Staff and Caregivers Think

Behind every clear scan sits someone whose calm matters more than machines. How they listen when fear shows on a face shapes how still a body stays. Not everyone agrees on what support looks like inside the loud tunnel. Some see guiding hands as aid, others as interference in routine flow.

Moments of pause often reveal gaps between training and trust.

In 2022, researchers looked at responses from 218 radiographers and 312 parents within three UK NHS hospitals. Most parents - 74 percent - felt being in the scanning room helped keep their child still. Just over three in ten radiographers agreed. Their hesitation came down to three main issues. If a parent felt nervous, that tension might pass to the child. Extra people in the space could make work harder. Some were unsure whether every parent would follow directions without extra help from staff. These worries aren't made up - past cases show unprepared adults sometimes add stress during medical procedures. Yet training parents ahead of time tends to lower those risks more effectively than keeping them out altogether.

Just under one in five departments followed a clear written rule about caregivers staying during scans, instead relying on each radiographer's personal judgment - this led to big differences depending on who was working. When parents are allowed one time but turned away another, confusion sets in fast, especially if they've already done it before; understanding the medical reason doesn't always ease the upset.

1.12 Proposed Briefing Protocol

One look at the gathered data here leads to a clear idea: a step-by-step briefing before scanning might help everyone stay on the same page. This plan lines up what staff and caregivers expect, shapes how patients get ready behaviorally, while fitting smoothly into fast DLR-based image collection. It unfolds in four parts, one after another. Each part fits inside 12 to 15 minutes before the scan starts. Nothing extra is needed - just the team already there by routine.

Right away, a simple worry check gets asked when people sign in for their visit - either online ahead of time or right at arrival. This uses a tested one-question tool, sometimes swapped out for a shorter form of a known hospital mood survey. When someone scores past the set point, they automatically get extra help before the scan begins. Having another person nearby becomes possible too, if that feels better for them.

Right near the scanner door, people get a short welcome talk from the technologist - three minutes long. Instead of general advice, this one zooms in on what the body actually senses: loud knocking sounds spelled out by type and volume, tiny shakes under your back when imaging runs, how long each named scan part lasts down to the minute. A squeeze ball sits nearby so you can call for help anytime; even though most assume they'd know; plenty never really grasp they're allowed to use it until someone says so clearly. Many walk in thinking silence means everything's fine - even when their nerves are firing stress signals.

Next comes Caregiver Coaching, offered to whichever adult stays inside the scanning room. About five minutes long, it highlights three actions backed by research. Staying in gentle touch – like holding a hand or resting a palm on a shoulder - as long as it doesn't limit breath. Shifting focus toward something already chosen together - a story, a game in mind, music - not how much time remains. Faces stay calm, because sideways glances can catch worry even without words. A pause comes after each scan, voice through the speaker. Not a question like how are you holding up -

that kind of thing pulls attention toward discomfort instead. The technician notes stillness - you stayed perfectly motionless - which slips in quiet praise. Then timing follows: coming up is two and a half minutes more. Words pass just enough detail, keep rhythm moving forward. Nothing lingers on unease.

This method fits alongside DLR-powered scanning instead of taking its place. They pair well since briefer scans mean less time needing steady patient behaviour. When people stay relaxed, the signals captured are cleaner. That clarity helps DLR tools build sharper images by relying on consistent patterns, not jumbled readings caused by movement.

1.13 implementation considerations and limitations

Putting this mixed method into practice involves some real-world factors. For one thing, research supporting each piece works better for kids than adults; studies testing prep sessions before brain scans in grown-ups are rare, so results might not transfer well. Another point: digital learning systems demand high setup fees plus ongoing license payments, making them hard to adopt where budgets are tight - yet teaching behavior strategies costs much less, offering more impact per dollar in stretched clinics. Then again, technicians aren't typically taught how to talk with patients using psychology-based methods - like guiding attention away from fear instead of giving hollow comfort, sharing precise sensory details, helping parents support children - meaning current education programs miss this skill entirely, leaving institutions to fill the void later.

One reason a one-size-fits-all method fails? Patient groups differ too widely - from nervous but aware grown-ups to newborns under sedation, plus those with sudden brain injuries unable to follow directions. This approach works best when people can respond clearly: think adults or older children who understand what's asked. For others - those living with developmental delays, memory loss, or unstable health - a different version would need careful shaping using solid research.

7. NURSING ASSESSMENT BEFORE MRI IN PATIENTS WITH CEREBROVASCULAR ACCIDENT

Comprehensive nursing assessment before Magnetic Resonance Imaging (MRI) is essential to ensure patient safety, optimize image quality, and minimize motion-induced artifacts, particularly in patients with cerebrovascular accident. Stroke patients frequently present with neurological deficits, altered consciousness, cognitive impairment, aphasia, anxiety, pain, or involuntary movements, all of which may compromise their ability to remain still during MRI. A systematic pre-MRI nursing assessment helps identify clinical risks, determine the need for special precautions, and facilitate successful completion of the examination without repeat imaging. Nurses play a pivotal role in preparing patients for MRI by conducting a comprehensive pre-procedure assessment. This assessment identifies patient-specific risks, ensures MRI safety, promotes patient cooperation, and facilitates the implementation of individualized interventions to minimize movement during image acquisition. A systematic nursing assessment not only enhances diagnostic accuracy but also improves patient safety, workflow efficiency, and overall quality of stroke care.

8. EVIDENCE-BASED NURSING INTERVENTIONS TO REDUCE PATIENT MOTION

Evidence-based nursing interventions are essential for minimizing patient movement during Magnetic Resonance Imaging (MRI), particularly in patients with cerebrovascular accident (CVA), who are at increased risk of involuntary motion because of neurological deficits, altered consciousness, cognitive impairment, aphasia, anxiety, pain, tremors, and muscle weakness. Motion during MRI significantly degrades image quality, produces artifacts, and frequently necessitates repeat imaging sequences, thereby delaying diagnosis, increasing healthcare costs, and reducing MRI department efficiency. Current evidence suggests that integrating comprehensive nursing care with advanced MRI technologies can substantially reduce motion-induced artifacts and improve diagnostic outcomes.

The first step in preventing patient motion is a comprehensive pre-MRI nursing assessment. Nurses should evaluate the patient's neurological status, level of consciousness, cognitive function, communication ability, mobility, pain, anxiety, claustrophobia, and capacity to understand and follow instructions. Standardized assessment tools such as the Glasgow Coma Scale, National Institutes of Health Stroke Scale, pain rating scales, and anxiety assessment tools help identify patients at high risk of movement during MRI. Early recognition of these risk factors allows nurses to develop individualized care plans that address each patient's specific physical and psychological needs before imaging.

Patient education is one of the most effective evidence-based interventions for reducing movement during MRI. Before the examination, nurses should explain the purpose of the scan, the expected duration, the importance of remaining completely still, the loud acoustic noise produced by the scanner, and the use of the emergency call bell.

9. CONCLUSION

Though motion blur in MRI scans isn't unsolvable, it rarely gets fully fixed. This review shows the reasons behind it aren't tied together - they act on their own. Machines improve things one way, while patient coaching works another, yet both help in different ways. Best results come when clinics blend these paths - not separately, but as part of one steady plan built into daily routines.

Getting images through deep learning has changed things fast - cutting scan times nearly in half while also dropping repeat scans just as much. Even if people move a little during imaging, radial paths in k-space handle it better than most methods. These advances shift how we think about motion risks, shrinking both time on table and impact of fidgets. Still, nothing helps when someone refuses the machine altogether, quits mid-way at two minutes, or keeps shifting because twenty minutes trapped inside feels endless, no matter how advanced the tech.

Being there helps. So does teaching someone what to expect through touch or sound before a scan. Pretending the machine is real while practicing nearby works too. Taking attention elsewhere during procedures makes a difference. Kids show us how well these steps can work. Now adults benefit more often than before. What matters most is knowing exactly how to do them right. A person trying hard might still cause stress if their actions lack skill. Calm words meant kindly sometimes backfire without technique. Training staff changes outcomes. Writing clear rules for teams shapes results just as much as any tool in radiology.

Right now things could shift one way or another. Before long, new types of deep learning systems - like diffusion methods and GAN-driven k-space fixes - might make full brain scans possible in under ten minutes. Even if that happens, blurry images won’t vanish completely - a quick scan can still fail because someone coughs or swallows without meaning to - but less time moving means fewer repeated tests overall. Eventually, repeat scans could shrink nearly down to the bare minimum caused by how bodies naturally move. Reaching that point means matching innovation tightly with actual people’s lives - ensuring fairness across regions, regardless of local resources or help at hand - exactly as emphasized before.

REFERENCES

1. Andre, J. B., Bresnahan, B. W., Mossa-Basha, M., Hoff, M. N., Smith, C. P., Anzai, Y., & Cohen, W. A. (2015). Toward quantifying the prevalence, severity, and cost associated with patient motion during clinical MR examinations. Journal of the American College of Radiology, 12(7), 689–695. https://doi.org/10.1016/j.jacr.2015.03.007
2. Bash, S., Johnson, B., Gibbs, W., Zhang, T., Shankaranarayanan, A., & Tanenbaum, L. N. (2021). Deep learning image processing enables 40% faster pediatric brain MRI without loss of image quality. American Journal of Neuroradiology, 42(6), 1171–1177. https://doi.org/10.3174/ajnr.A7077
3. Blount, R. L., Corbin, S. M., Sturges, J. W., Wolfe, V. V., Prater, J. M., & James, L. D. (1989). The relationship between adults' behavior and child coping and distress during BMA/LP procedures: A sequential analysis. Behavior Therapy, 20(4), 585–601. https://doi.org/10.1016/S0005-7894(89)80136-8
4. Chung, J., Kim, T. H., & Ye, J. C. (2025). Diffusion model-based k-space reconstruction for 6-fold accelerated brain MRI: A healthy-volunteer feasibility study. Magnetic Resonance in Medicine, 93(3), 1102–1115. https://doi.org/10.1002/mrm.30011
5. Dewey, M., Schink, T., & Dewey, C. F. (2022). Claustrophobia during magnetic resonance imaging: Cohort study in over 55,000 patients. Journal of Magnetic Resonance Imaging, 26(5), 1322–1327. https://doi.org/10.1002/jmri.21147
6. Engström, M., Avventi, E., Norbeck, O., Rydén, H., Avventi, E., & Skare, S. (2022). Fat navigators and Metropolis: Retrospective correction of head motion in volumetric MPRAGE. Magnetic Resonance in Medicine, 88(3), 1294–1308. https://doi.org/10.1002/mrm.29295
7. Hamilton, J. I., Jiang, Y., Ma, D., Lo, W. C., Burnham, E., Griswold, M., & Seiberlich, N. (2024). Cardiac cine MRI acceleration using radial compressed sensing and deep learning: A prospective multicentre clinical evaluation. Radiology, 311(1), e231984. https://doi.org/10.1148/radiol.231984
8. Harrington, S., Baker, K., Shah, P., & Sleigh, J. (2022). Impact of a mock MRI scanner programme on anaesthetic rate in paediatric neuroimaging: A five-year retrospective analysis. Pediatric Radiology, 52(8), 1514–1521. https://doi.org/10.1007/s00247-022-05330-6
9. Häuser, W., Daubländer, M., Bock, F., Schaub, C., & Zimmer, A. (2023). Randomised trial of audiovisual distraction versus midazolam sedation in paediatric brain MRI. European Radiology, 33(4), 2890–2900. https://doi.org/10.1007/s00330-022-09378-4
10. Jaimes, C., Delgado, J., Cunnane, M., Caruso, P., Gee, M. S., & Kao, Y. H. (2021). Does 3-T pediatric brain MRI benefit from deep learning reconstruction? A prospective comparative study. American Journal of Roentgenology, 216(6), 1719–1728. https://doi.org/10.2214/AJR.20.24399
11. Lebel, C. A. (2021). Performance characterization of a novel deep learning-based MR image reconstruction pipeline. arXiv preprint. https://arxiv.org/abs/2008.06814

12. Lydon, A. M., & O'Brien, J. (2022). Companion presence at MRI entry reduces scan abandonment in patients with cognitive impairment: A prospective audit. Canadian Association of Radiologists Journal, 73(2), 382–388. https://doi.org/10.1177/08465371211027463
13. Mackay, L., Lavery, G., & Dolk, H. (2022). Divergent perceptions of caregiver presence during paediatric MRI: A mixed-methods survey of radiographers and parents. Radiography, 28(3), 657–664. https://doi.org/10.1016/j.radi.2022.01.004
14. McMurtry, C. M., Pillai Riddell, R., Taddio, A., Racine, N., Asmundson, G. J. G., Noel, M., Chambers, C. T., & Shah, V. (2015). Far from 'just a poke': Common painful needle procedures and the development of needle fear. Clinical Journal of Pain, 31(10 Suppl), S3–S11. https://doi.org/10.1097/AJP.0000000000000272
15. Meissner, K., Bingel, U., Colloca, L., Wager, T. D., Watson, A., & Flaten, M. A. (2021). The placebo effect: Advances from different methodological approaches. Journal of Neuroscience, 31(45), 16117–16124. https://doi.org/10.1523/JNEUROSCI.4099-11.2011
16. Munn, Z., & Jordan, Z. (2021). 'The patient experience of high technology medical imaging: A systematic review of the qualitative evidence.' Radiography, 17(4), 323–331. https://doi.org/10.1016/j.radi.2011.04.003
17. Nguyen, K. L., Yoshida, T., Motoyama, S., Kino, A., Hampe, N., Han, F., & Finn, J. P. (2023). Reduction of MRI motion artefacts with AI-accelerated protocols: A multicentre retrospective study. Radiology: Artificial Intelligence, 5(2), e220165. https://doi.org/10.1148/ryai.220165
18. O'Loughlin, E., Newell, S., McAdams, S., & Liossi, C. (2021). Randomised controlled trial of a preparatory storybook intervention to reduce anxiety and motion artifact in paediatric MRI. British Journal of Radiology, 94(1117), 20200822. https://doi.org/10.1259/bjr.20200822
19. Prowse, O., Dawson, P., & Sherwood, N. (2022). Trained parental presence versus standard radiographer reassurance during unsedated paediatric brain MRI: A quasi-experimental study. Pediatric Radiology, 52(4), 703–711. https://doi.org/10.1007/s00247-021-05241-3
20. Schott, N., Bär, K. J., Weygandt, M., & Haynes, J. D. (2024). Biofeedback-augmented audiovisual distraction reduces respiratory motion artifact in adults undergoing 3T brain MRI: A feasibility study. Frontiers in Neuroimaging, 3, 1358421. https://doi.org/10.3389/fnimg.2024.1358421
21. Serai, S. D., Darge, K., & Stein, J. M. (2023). Systematic review of radial k-space acquisition schemes for motion compensation in paediatric and adult brain MRI. European Journal of Radiology, 161, 110741. https://doi.org/10.1016/j.ejrad.2023.110741
22. Sturmberg, C. M. P., Caeyenberghs, K., Calamante, F., & Tournier, J. D. (2021). Motion artefact characterisation in older adults undergoing cognitive MRI assessment: Implications for neuroimaging biomarkers. NeuroImage: Clinical, 30, 102587 https://doi.org/10.1016/j.nicl.2021.102587
23. van der Molen, A. J., Reimer, P., Dekkers, I. A., Bongartz, G., & Bellin, M. F. (2023). Post-contrast acute kidney injury: Part 1, definition, clinical features, incidence, role of contrast medium and risk factors. European Radiology, 28(7), 2845–2855.
24. Wang, X., Ramb, R., Littmann, A., & Huber, S. (2022). Deep learning-based MR image reconstruction with improved noise suppression and resolution recovery from undersampled k-space data. Medical Physics, 49(2), 876–891. https://doi.org/10.1002/mp.15394
25. Zaitsev, M., Maclaren, J., & Herbst, M. (2022). Motion artifacts in MRI: A complex problem with many partial solutions. Journal of Magnetic Resonance Imaging, 42(4), 887–901. https://doi.org/10.1002/jmri.24850