REVIEW

Managing Claustrophobia and Anxiety in Diagnostic MRI and Radiotherapy Immobilization

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Abstract

Patient immobilization in both Magnetic Resonance Imaging (MRI) and radiotherapy is necessary for better image quality in MRI and accurate treatment in radiotherapy. However, patients experience increased anxiety levels or claustrophobia due to the utilization of tight thermoplastic masks in radiotherapy and narrow bores in diagnostic MRI. This narrative review study focuses specifically on non-pharmacological strategies categorized into physical, environmental, and psychological approaches to identify safe, cost-effective, and efficient methods for mitigating claustrophobia and anxiety in MRI and radiotherapy settings.

To compare strategies of anxiety management across both modalities, this study reviewed the 2015–2026 literature in PubMed, Google Scholar, and ScienceDirect. After reviewing the studies, they were grouped into three types: physical, environmental, and psychological approaches. Findings showed that physical interventions, such as open-face masks and open-bore MRI systems, gradually decrease anxiety and scan termination rates without negatively affecting clinical accuracy. Moreover, environmental distractions such as patient-selected music and immersive audiovisual systems demonstrate high effectiveness in reducing acute procedural distress. The studies strongly suggest that hospital sectors need to identify patients with anxiety or claustrophobic risk before the procedures, using tools such as questionnaires designed to identify anxiety levels. Patient-comfortable hardware is necessary early identification and communication training of the radiographer remain.

Keywords: claustrophobia; magnetic resonance imaging, patient anxiety; patient immobilization; radiotherapy; thermoplastic masks

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The authors declare no conflict of interest

1 | Introduction

Magnetic Resonance Imaging (MRI) and radiotherapy are essential diagnostic and treatment procedures in the present healthcare system. To ensure correct diagnosis and treatment planning, patient immobilization is vital. During MRI procedures, the acoustic noise and the narrow scanner bores often cause claustrophobic issues for patients. Many large-scale studies have shown that intervention is necessary during MRI examinations to overcome claustrophobic events (Napp et al., 2016). A large percentage of patients experience claustrophobic feelings during these procedures, which has led to patients completely refusing the treatment, causing delays, or leading to scan terminations (Bellhouse et al., 2021). Additionally, using rigid thermoplastic masks in head and neck oncology procedures is mandatory to maintain cranial immobility. However, this increases acute anxiety and distress in cancer patients.

Anxiety of the patients while undergoing an MRI has a profound impact not only on clinical findings but also on operational performance, especially in terms of patient discomfort and unnecessary movements (Napp et al., 2016**)**. These physical phenomena often cause extreme motion artefacts making the interpretation of image metrics difficult, and requiring repeat scan sequences which are costly, and time consuming. When rigid thermoplastic masks are used as the alternative method for head and neck radiotherapy, they cause anxiety from extreme restriction, and this can affect the rate of completing the fractions and can also trigger slight muscle contractions (Lundin et al., 2025).

These unintended responses lead to a decrease in the accuracy of dosimetric measurements. Planning Target Volume (PTV) may need to be expanded to cover geometric uncertainties (Glynn et al., 2022). Thus, increasing the target thresholds is likely to increase the possibility of an unintended radiation dose to healthy anatomical structures and to reduce the intended radiation dose to the target tumor volume. A recent study shows that the optimization of physical architecture of an open-face mask will provide an important clinical alternative to rigid confinement without compromising geometrical replication limits (Keane et al., 2024).

While pharmacological interventions like sedatives and anesthesia are commonly used for managing anxiety in both paediatric and adult patients, they carry significant clinical disadvantages. These methods often lead to workflow delays, increased hospital costs, and the requirement for post-procedural monitoring. For instance, abdominal MRI scans typically require specific breath-hold techniques to minimize respiratory motion artifacts. When patients are under sedation or anaesthesia, they are unable to follow these breathing instructions, which may result in degraded image quality. This review focuses specifically on non-pharmacological strategies categorized into physical, environmental, and psychological approaches to identify safe, cost-effective, and efficient methods for mitigating claustrophobia and anxiety in MRI and radiotherapy settings.

2 | Methods

The narrative literature review, searched the databases Google Scholar, PubMed and ScienceDirect. The search strategy included using keywords, such as Magnetic Resonance Imaging, Radiotherapy, Claustrophobia, Anxiety, Immobilization Masks, and Patient Comfort. Studies using English language between 2015 and 2026 that targeted individuals within the adult population and who were undergoing radiotherapy treatments or associated imaging procedures were included in the study. Articles dealing only with the physical aspects and articles relating to paediatric populations with results that could not be extrapolated to the adult population of mask training were omitted.

A total of 65 records resulted from the first literature search done across all the databases. Following an initial screening, 5 duplicate records were removed. The full texts of the remaining articles were carefully scrutinized for eligibility, with 27 excluded because inaccessible full-texts were available, 10 were not directly related to the study objectives and 8 because no new elaborative qualitative or quantitative information was provided. In total, 15 final articles fulfilled all predefined criteria and were

part of the descriptive narrative synthesis. This entire process of literature identification and literature selection is explained in Figure 1.

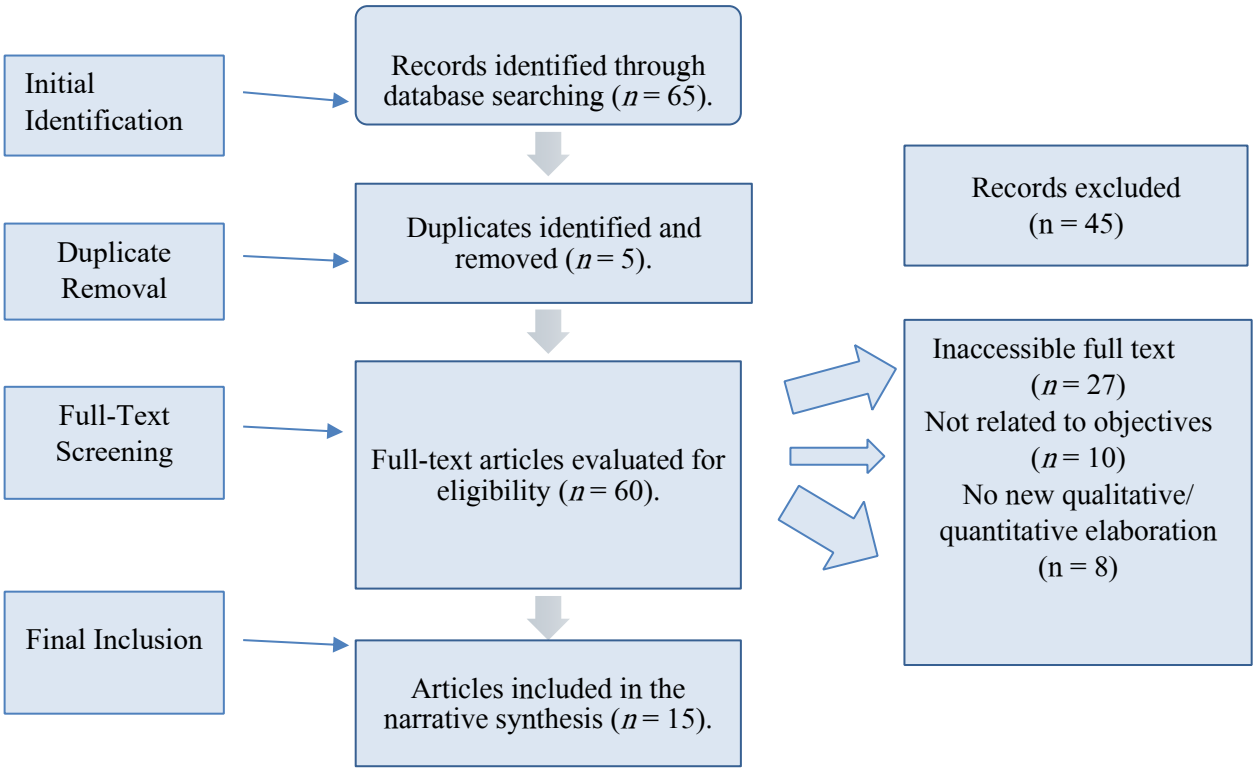

Figure 1. Literature Selection Flowchart Outlining the Identification, Screening, and Inclusion of the 15 Final Articles for This Narrative Review.

3 | Results

Although diagnostic MRI and radiotherapy immobilization differ procedurally, the literature shows that both employ broadly similar strategies to manage claustrophobia and anxiety. The literature search yielded 15 relevant studies that met the inclusion criteria. Table 1 provides a summary of the key characteristics, investigated strategies, and primary findings of these included studies.

1. Physical Interventions

Open-face thermoplastic masks are always associated with less anxiety, discomfort, and pain than closed-face cranial and head-and-neck treatments, especially in radiotherapy. According to Keane et al. (2024) the level of discomfort, (VAS 0.5 vs 3.3) anxiety, and pain were significantly lower, and 93% of the patients preferred open-face designs. Wiant et al. (2016) also presented the removal of severe claustrophobia that needed to be treated.

These psychological advantages could not be linked with clinically significant decreases in immobilization accuracy. Researchers have not identified any significant differences in setup accuracy or intrafraction motion, especially when used together with surface-guided radiotherapy. Similarly, three studies (Glynn et al., 2022; Keane et al., 2024; Wiant et al., 2016), found marginal changes in setup uncertainty, but these changes were within reasonable clinical ranges. The qualitative data suggest that open-face masks increase the perceived power and decrease the panic, and treatment breaks are found only in closed-mask cohorts (Lundin et al., 2025).

Table 1: Summary of Included Studies

Author (Year)	Modality	Sample Size	Strategy / Intervention Assessed	Key Findings
Behluli et al. (2024)	Diagnostic MRI	n=118	Open upright vs. conventional closed MRI	Open MRI resulted in significantly lower rates of claustrophobia (18.4% vs 58.3%) and reduced the need for sedatives.
Bellhouse et al. (2021)	Diagnostic MRI	n=29	Standard MRI planning scan	34% withdrew due to pain or claustrophobia; highlights the need for screening and optimized patient positioning.
Glynn et al. (2022)	Radiotherapy	n=60	Open mask for anxious patients vs. closed	Open masks are viable for highly anxious patients, maintaining comparable accuracy but requiring a slight PTV margin increase.
Hasan & Hajee (2025)	Diagnostic MRI	n=125	Open vs. closed MRI	Closed MRI induced elevated heart rates and reduced oxygen saturation in claustrophobic patients compared to open MRI.
Iwan et al. (2021)	Diagnostic MRI	n=160	Survey of scanner design preferences	Patients visually favored open designs; acceptance of short-bore scanners increased when educated on diagnostic performance.
Keane et al. (2024)	Radiotherapy	n=30	Open-face vs. closed immobilization mask	Open masks resulted in significantly lower patient discomfort and anxiety with clinically acceptable immobilization.
Lawal et al. (2024)	Diagnostic MRI	n=7	Supportive instruction by radiographers	Radiographer communication is central to patient experience; barriers include time constraints and lack of formal training.
Lundin et al. (2025)	Radiotherapy	n=20	Open-face vs. closed mask	60% of patients preferred the open mask; 9% withdrew early specifically because they could only tolerate the open mask.
Moreira et al. (2024)	Radiotherapy	n=205	Bundled care (pre-screening, education, music)	Resulted in very low MR-related anxiety and 100% treatment completion despite lengthy MR-Linac fraction times.
Napp et al. (2016)	Diagnostic MRI	n=6,520	CLQ screening tool evaluation	High baseline claustrophobic event rate (9.8%); the CLQ demonstrated excellent negative predictive value for ruling out events.
Nixon et al. (2019)	Radiotherapy	n=35	Multidisciplinary care (music, mask modifications)	Mask anxiety decreased over time; communication with health professionals and self-taught strategies were rated most helpful.

Pelland et al. (2025)	Radiotherapy	n=410	Development of R-MAQ screening tool	27.3% had an anxious response; the 4-item R-MAQ accurately predicted mask anxiety.
Shimokawa et al. (2022)	Diagnostic MRI	n=61	Audiovisual (AV) system vs. standard MRI	The AV system successfully relieved anxiety in highly anxious patients, though it showed no significant difference for the overall cohort.
Westerhoff et al. (2024)	Radiotherapy	n=66	In-room calming video monitor during MR-Linac	41% chose to watch videos for distraction; anxiety scores decreased significantly after the first treatment session.
Wiant et al. (2016)	Radiotherapy	n=45	Open-face vs. closed thermoplastic mask	Comparable immobilization accuracy; lower anxiety and claustrophobia scores observed in the open-mask group.

Open, upright and wide bore systems are always linked with reduced prevalence of claustrophobia, premature scan acquisition, and the use of sedatives compared to the closed bore scanners. With these, according to Behluli, the prevalence of claustrophobia decreased from 58.3 to 18.4 percent, and scan termination and sedatives were both lowered (Behluli et al, 2024). Physiological proofs are available in the form of the decreased stress reaction in open MRI, such as decreased heart rates and increased oxygen saturation (Hasan & Hajee, 2025).

Additional factors that influence tolerance are bore length, diameter and position of patient. Bellhouse found that 34% of lung cancer patients who underwent MRI scanning in a radiotherapy workflow withdrew, especially where positioning minimized the perceived internal space. The patients that had gone through the scans showed a considerably reduced scan-specific anxiety ($p < 0.05$) (Bellhouse et al., 2021).

2. Environmental and Sensory Interventions

Distraction and sensory modulation are some of the environmental interventions that help in reducing anxiety, and make people less aware of confinement. Auditory distraction is the most popular method in radiotherapy, where movements are limited by the intervention technique. Music chosen by patients has been proven to be consistently helpful. Nixon stated that 72% of head-and-neck patients with mask-related anxiety found music effective in alleviating distress whereas in more than 85% of patients, music was used compared to other non-pharmacological interventions, which were found to have no significant clinical effect (Nixon et al., 2019).

Visual distraction has also been considered in MR-guided radiotherapy. According to Westerhoff 41% of the patients in the cited study chose to watch calming videos during the treatment process, and more than 90% rated the intervention as helpful (Westerhoff et al., 2024). Though the general anxiety level is reduced after the treatment, high uptake favors the use of visual distraction as a viable adjunct in the case of sustained immobilization.

Immersive audiovisual environments have been more widely applied in diagnostic MRI. Shimokawa discovered that higher anxiety patients with the use of the audiovisual systems significantly reduced to lower anxiety levels after the scan, at 81.8% compared to 42.9% in the conventional situation (Shimokawa et al., 2022). Multisensory environments are more commonly applied to diagnostic MRI as compared to radiotherapy.

3. Educational and Psychological Interventions

Radiotherapy is currently placing a stronger focus on early screening and organized psychological support. A major milestone in this effort is the development of the Radiotherapy Mask Anxiety Questionnaire (R-MAQ). A study by Pelland involving a cohort of 410 patients where 27.3% demonstrated an observable anxious response—validated the tool's strong predictive capabilities (AUROC = 0.78). The questionnaire achieved acceptable sensitivity (67.9%) and specificity (76.2%) at a threshold score of ≥ 4, outperforming the generic Claustrophobia Questionnaire (CLQ) in identifying patients at risk of immobilization-induced distress (Pelland et al., 2025). Utilizing structured care models that integrate such early screening protocols alongside targeted patient education and continuity of care yields high patient satisfaction and remarkably low anxiety levels, ensuring a 100% treatment completion rate even during lengthy MR-guided treatments (Moreira et al., 2024).

The general screening in diagnostic MRI is often based on the Claustrophobia Questionnaire (CLQ) that has high negative predictivity but is not good at identifying patients that are at high risk (Napp et al., 2016). Communication between radiographers and patients during pre-scan education is paramount in improving tolerance, but the effect is limited by time and resources (Lawal et al., 2024). Education has also been indicated to change the preferences of scanners and enhance the acceptance of short-bore MRI in high-risk patients (Iwan et al., 2021).

4 | Discussion

Divergent Approaches to a Shared Challenge

Both diagnostic MRI and radiotherapy procedures cause patient discomfort, usually with the same physical reactions such as tachycardia and patient movement due to anxiety levels arising during the procedures. Although these are two different procedures, the same kind of reactions occur. In MRI procedures, the main discomfort comes from the size of the small bore and the acoustic noise generated by the machine. The main stress coming from radiotherapy procedures in the head and neck area is restraint-based, because closed masks are used to restrict the movement of the patient. Hence, the two different procedures need different methods to overcome this discomfort for the patients while performing accurate procedures. For MRI procedures, environmental factor modifications are needed, while radiotherapy equipment accessories, like closed masks, need to be modified to overcome the above discomfort for the patient.

The Physical Interface

"Openness" as the Standard The best practice to overcome this discomfort level in both procedures is openness. Existing literature demonstrates that the “open level” of the physical space is the method to overcome this discomfort. In radiotherapy procedures, shifting from closed-face to open-face masks significantly reduced discomfort. Evidence demonstrates that the “mask experience” is the most critical factor affecting patient comfort Previously, clinicians held the idea that full masks aided accurate procedures; However, studies have demonstrated that open-face masks, when used alongside modern Surface Guided Radiotherapy (SGRT), preserve clinical accuracy while greatly reducing patient discomfort. As a result, open-mask techniques should be the primary standard for all head and neck radiotherapy procedures rather than a specialized option for anxious patients (Keane et al., 2024; Wiant et al., 2016).

Psychological Mechanisms: Distraction vs. Desensitization

This review demonstrates a critical distinction in psychological management: the difference between distraction and desensitization. MRI protocols are typically one-time procedures for patients. For a single acute MRI examination, the success of immersive audiovisual systems relies on mentally removing the patient from the room (Shimokawa et al., 2022). Hence, the distraction process is suitable

for MRI procedures. However, radiotherapy procedures are not single events. Usually, they are continuous treatments lasting from weeks to months. The utilization of distraction techniques might work on the very first day, but the efficacy of the process can be lost several days later. Therefore, the literature emphasizes desensitization and adaptation for radiotherapy patients. Patients at the beginning of treatment were able to complete the treatment after the introduction of an open mask, in one study (Lundin et al., 2025)

Economic and Workflow Implications

While very few studies examine the economic implications regarding these procedures, "procedural failure" defined as an aborted MRI scan or an unfinished radiotherapy fraction represents a significant waste of resources. A cancelled slot due to panic in MRI procedures wastes around 45 minutes of scanner time, creates waiting list backlogs, and usually requires re-booking with the support of costly anaesthesia (O AlRowaili et al., 2016). Therefore, investing in a wide-bore magnet or an immersive audiovisual system may provide a return on investment by maximizing throughput. Moreover, patients who cannot tolerate the mask disrupt the linear accelerator schedule in radiotherapy procedures, delaying treatment for subsequent cancer patients. The utilization of open-face masks is slightly more expensive than using closed-face masks, but it is much more cost-effective than rescheduling a new treatment or psychological interventions (Mulla et al., 2020). Future studies should explicitly quantify these savings to support the business case for anxiety-reducing technologies.

The Role of Screening and Staff Training Diagnostic

MRI procedures often use the generic Claustrophobia Questionnaire (CLQ), while radiotherapy is moving toward context-specific tools such as the R-MAQ for the early identification of at-risk individuals (Pelland et al., 2025). The most effective way to allocate resources is to implement special screening protocols before the patient enters the room. Moreover, radiographers need to be trained on anxiety de-escalation techniques. One study demonstrated that radiography staff often lack the time and formal training to employ advanced communication strategies. (Lawal et al., 2024). This suggests that along with purchasing new masks or projectors, departments should invest in staff training for rapid anxiety de-escalation techniques.

Limitations

In this review, direct statistical comparisons are challenging because the research papers range from observational surveys to randomized controlled trials. Furthermore, due to the heterogeneity of the included studies, the ability to compare results is limited. Moreover, the definition of "anxiety" varied; while some studies used validated scales such as STAI (State-Trait Anxiety Inventory) and HADS (Hospital Anxiety and Depression Scale), others relied on simple patient-reported feedback. Additionally, the comparative findings are constrained by the relatively small sample size of the 15 studies, limiting the ability to draw definitive, universally applicable conclusions. Finally, the literature reviewed primarily consists of international studies, highlighting a notable lack of local comparative research. This restricts the ability to fully understand how regional, cultural, or demographic differences might influence patient experiences and the effectiveness of these anxiety management strategies.

5 | Conclusions

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This review shows that managing patients with anxiety and claustrophobia during both MRI and radiotherapy is essential for ensuring image quality in MRI and accuracy in radiotherapy treatment. The "trapped" feeling arises in two different ways due to the nature of the procedures; hence, almost completely different methods are needed for patient comfort.

During MRI scans, the main source of anxiety arises from the environment due to the structure of the machine. Because of that, patient distraction methods, such as utilizing audiovisual screens, along with open-bore scanners, may be used to ensure patient comfort without causing panic.

For successful radiotherapy treatment, patient desensitization and adaptation are needed. The reviewed literature supports the adoption of the open-face mask, which has aided in reducing patient anxiety without changing geometric accuracy. Pre-planning should be prioritized with questionnaires to identify claustrophobic patients as a key strategy to avoid these negative outcomes. In both MRI and radiotherapy procedures, the early identification of panic attack risks before the patient gets on the procedure table is important alongside introducing wide-bore MRI scanners and open-mask methods.

Author Contributions

U. L. P. D. K.A: Conceptualized the study, designed the methodology, Abstract and Keywords, Writing -Review & Editing, Project Administration

W.V.A.S.L: Investigation (Literature Search), Data Curation, and Writing – Original Draft

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