Exploring patient perceptions of the current breast radiotherapy pathway and a future upright radiotherapy solution

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Exploring patient perceptions of the current breast radiotherapy pathway and a future upright radiotherapy solution

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ABSTRACT

Introduction: Breast cancer remains a major global health challenge. Around 60 % of patients receive radiotherapy as part of their treatment, typically in the supine position. Upright positioning offers an alternative, potentially reducing treatment room costs. This study explored patient perceptions of (i) conventional supine treatments and (ii) upright positioning.

Methods: Women with lived experience of breast radiotherapy joined a participatory co-design workshop with healthcare practitioners, academics, and industry researchers. The workshop included three stages: 1) Sharing Experiences, participants discussed lying-down radiotherapy, including positioning aids and in-room experience; 2) Improving Experience, the group explored ideas to enhance patient experience; 3) Upright Experience, participants sat for 10 min in a demonstrator upright radiotherapy chair, provided comfort scores, comments, and completed short questionnaires comparing it to supine treatment.

Discussions were audio-recorded, transcribed, and analysed using framework analysis. A live-drawing artist captured key themes. Participants sense-checked reported themes to ensure trustworthiness.

Results: Ten women aged 37–69 years participated; 80 % were white British and 20 % mixed heritage. Time since radiotherapy ranged from 9 months to 4 years. Six themes emerged: 1) Everyone has a different journey, 2) The whole journey is hard, 3)"Radiotherapy will be a breeze", 4) Understanding positioning and environment, 5) The 'worst' radiotherapy service: what might that look like? 6) The 'best' radiotherapy service: what might that look like?

Overall, upright positioning was viewed favourably: 77.8 % of participants found the upright demonstrator chair comfortable, compared with 11.1 % for supine position experienced for treatment (n = 9).

Conclusion: This study reinforces previous research findings on the emotional and physical experiences of supine radiotherapy; new insights were patient-determined service improvements.

Implications for practice: Upright radiotherapy may improve comfort and emotional well-being, offering new opportunities for patient-centred radiotherapy.

Introduction

Breast cancer continues to be a major health challenge globally, with over 2 million cases diagnosed in 2020.[1] In the UK, around 60 % of patients diagnosed with breast cancer receive radiotherapy as part of their treatment.[2] Based on historical practice, patients are generally treated in the supine position; occasionally patients with larger breasts may be treated prone and infrequently the lateral decubitus position may be adopted.[3] The development of gantries which rotate 360° around a supine patient has allowed radiation to be delivered from any angle. However, gantry-based solutions require large treatment rooms with heavy shielded walls. For conventional radiotherapy using photons, gantries

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weigh ≈5 tonnes, but for radiotherapy using protons, gantries can weigh up to 200 tonnes.[4] They are expensive and logistically complex installations that can be difficult to incorporate within existing hospital architecture, where space and access can be limited.

An alternative approach is to treat using upright body positioning, slowly rotating the patient rather than the radiation beam. This method reduces the requirement for primary radiation shielding to one direction only and removes the need for a rotating gantry, leading to cost and space savings. Equipment for upright radiotherapy has evolved substantially over recent years, a variety of in-house and commercial systems have been developed.[5] A recent review suggested that "upright positioning could provide some patients a more comfortable and potentially clinically equivalent if not superior option for radiation therapy".[6] In this work we were interested in understanding[1] patient perceptions of the conventional breast radiotherapy pathway and[2] how upright radiotherapy might offer a different experience for patients.

It is well known that certain patients with co-morbidities can find lying down for radiotherapy uncomfortable. For example, those with heart conditions, lung co-morbidities or obesity.[7] These patients may find upright body positioning more tolerable. Specifically, there is evidence that, on average, lung volumes are greater,[8] and measures of respiratory airflow are typically increased,[9] for upright body positions.

There is much that we still do not understand about women's experience of radiotherapy for breast cancer, and how that experience may influence their ability to cope or return to work post therapy. In a small qualitative study[10] women reported disempowerment, a loss of self-confidence, fear, and lack of choice during radiotherapy. Elements of emotional and physical discomfort were indicated by participants in another qualitative study (n = 5; overall sample = 25).[11] There is a need to understand whether these experiences are reflected in different samples of patients, and whether patient positioning for radiotherapy may influence experience.

To-date, a single study has been published that includes patient perspectives of upright body positioning for breast radiotherapy.[12] Participants who received conventional, supine radiotherapy for breast cancer tested an upright patient positioner (Eve from Leo Cancer Care Ltd). The majority (7 out of 9) preferred upright positioning (mean age 63.5 years, maximum age 90 years).[12] However, the study did not include qualitative analysis of the participant experiences. The intention of the current study was to build on previous qualitative research[10], to understand:

1. Do these experiences hold true for another cohort of women with lived experience of breast radiotherapy, at another timepoint?
2. Based on women's experiences of radiotherapy in the supine position how could the radiotherapy pathway be enhanced to improve patient experiences and patient empowerment?
3. How might upright body positioning change the patient experience (including the design of arm positioning aids in an upright position)?

By learning about existing poor and positive experiences at the point of patient preparation, immobilisation, treatment, and aftercare, it is envisaged that patient-centred pathways and positioning aids can be developed which will meet patients' needs in the upright position. In addition, understanding patients' experiences is of importance to current practice for patients treated in the supine position.

The scope of the qualitative investigation was the whole radiotherapy pathway from planning to aftercare to establish what is desirable, comfortable, and fit for purpose.

Method

Ethical approval for this study was obtained from Sheffield Hallam University ethics committee (ER62921756).

A participatory co-design process was adopted in which women with lived experience of breast cancer radiotherapy collaborated with Healthcare Practitioners (HCPs),[13] academics and industrial researchers. With their valuable experience and perspective, participants were viewed as co-researchers.[14] The approach adopted was based on previous co-design research led by HP that had proved successful and was developed with patient advocates with lived experience of breast cancer radiotherapy.[10]

People who had undergone radiotherapy following a breast cancer diagnosis (lying down) were recruited through *Breast Cancer Now* and informal networks of patient advocates to join a face-to-face workshop. Inclusion criteria were as follows:

- Over 18 years old,
- Able to understand and speak English,
- Able to provide informed consent,
- Had radiotherapy for breast cancer in the last five years,
- Able to raise and lower themselves easily from a seated position.

Preparation for the workshop

Prior to attending the full-day workshop, participants were invited to annotate a schematic drawing of the current radiotherapy pathway (for radiotherapy lying down); they were asked to identify the points at which positive or negative experiences occurred; similar to the schematic used in prior research.[10] This information was used to start discussions in the first part of the workshop. Each participant was invited to use their notes made before the workshop to describe both positive and negative experiences throughout the radiotherapy pathway. The discussion was interactive at this point but having their notes allowed participants to reflect and offer their own individual experiences as well as interject and comment on others perspectives where they had similar or different experiences.

On arrival, participants were screened for medical issues which could affect their experience of using the upright chair (*see supplementary text*).

During the workshop

The workshop was divided into three sections (detailed below) led by HP and facilitated by JU and SH. HP and JU have experience of running and facilitating focus groups with patients diagnosed with breast cancer. Other members of the team (TU, SI, RT, JN) were observers and took notes for sections 1 and 2, and conducted the individual trials of the radiotherapy chair for section 3.

In the first section participants were encouraged to share their experiences of radiotherapy lying down. Participants were invited to discuss their experiences throughout the pathway from preparation to aftercare. Of particular relevance were experiences of positioning, views on positioning aids (such as wingboards for breast radiotherapy) and the in-room experience of radiotherapy.

Section 2 focussed on understanding how patient experiences could be improved. To facilitate this understanding, the workshop leaders asked participants to describe from their experiences of radiotherapy, what the 'worst radiotherapy service' might look like. Starting with the negative aspects allowed facilitators to work with the patient participants to develop the counter elements for the best perceived radiotherapy service. A live drawing artist with a background in therapeutic radiography (SS) captured the themes and issues identified in the conversations.

In section 3, participants were invited to sit for 10 min in a static demonstrator version of an upright radiotherapy chair (Eve from Leo Cancer Care Ltd).[12] Before commencing, the participants were asked whether they had any pre-existing hand, arm, shoulder or mobility issues and their responses were recorded. The backrest was angled back by 5° and the seat-pan was angled down by 15°. Individualised vacuum cushions were formed over the seat pan and for the lower back. "Arms up" upright positions were adopted for the duration of the appointment, participants trialled early prototypes of physical arm supports that had been designed by a multi-disciplinary team at Leo Cancer Care. The participants were asked to provide free comments and comfort scores while seated. Immediately after their appointments, SH guided participants through a short questionnaire considering their experience with the upright positioner and their previous experience lying down for radiotherapy. Participants were also invited to answer follow-on questions when they later reviewed the themes extracted from the qualitative research.

It is recognised that recalling experiences of radiotherapy has the potential to be upsetting. At the end of the workshop, participants were encouraged back to the present moment before leaving, and were provided with contact details of a charity that offered emotional support around breast cancer.

Sections 1 and 2 of the workshop were audiotaped and subsequently transcribed verbatim by a professional transcription service. The transcript was anonymised by the research team. Framework analysis[15] was used to organise the data. Initially data analysis was conducted independently by HP and JU who familiarised themselves with the transcript and each developed a set of codes. These were then discussed, and a set of categories was developed jointly. After further refinement, the proposed themes were agreed. Patient participants were invited to comment on the themes to ensure they reflected the workshop discussion accurately. This systematic approach was designed to ensure transparency and minimise bias.

Results

Ten patient representatives attended the workshop. Time since radiotherapy ranged from nine months to four years and seven months. All participants underwent supine radiotherapy. Participant age ranged from 37 years to 69 years; Body Mass Index (BMI) ranged from 23.1 to 42.9 (mean BMI = 29.0). Thirty percent of participants could be categorised as having a healthy BMI, 40 % were overweight, and 30 % were obese. The purpose of measuring and reporting BMI was to ensure that experiences across a spectrum of patient body shapes was obtained in case these influenced experiences of lying supine on the treatment couch. Nine participants had Sheffield postcodes; one had a Doncaster postcode, areas placed 30th and 32nd respectively in the UK deprivation index.[16] Participant ethnicity was 80 % white British, 20 % mixed heritage (Pakistani British Muslim; Greek-British).

HP and JU identified 84 separate codes in the initial, independent data analysis. These were concentrated into 14 categories; after further discussion and refinement, 6 themes were agreed (see Table 1). There were no significant changes to the themes after gaining participant feedback. The themes are described below. Quotations from participants are presented in Fig. 1; drawings by the live artist during the workshop discussion are presented in Figs. 2–4.

Table 1
Themes developed from the workshop discussion.

Theme	Brief description
Everyone has a different journey	Each patient had an individual experience, depending on their personal characteristics and their treatment pathway.
The whole journey is hard	This theme reflects the challenges of radiotherapy which were compounded by the physical and psychological impact of previous treatment(s), such as surgery and/or chemotherapy.
"Radiotherapy will be a breeze"	It was often suggested to participants that radiotherapy would be an easy experience compared to chemotherapy, which was not the case for most women.
Understanding positioning and the environment	This theme incorporates participants' need to maintain a position which was uncomfortable or painful, in a cold, uninviting environment while lying on a rigid board surrounded by 'alien' equipment.
The "worst" radiotherapy service: what might that look like?	Aspects included poor information provision and communication; lack of preparation; and making positioning difficult and painful.
The "best" radiotherapy service: what might that look like?	Aspects included promoting patient choice and control, having a named worker, and creating a less clinical environment with pleasant distractions, such as music.

Key themes

Everyone has a different journey

Reflecting participants' different diagnoses, variation in their treatment pathways was evident, including the point at which radiotherapy was provided. Some participants had extensive surgery including lymph node removal, while others needed less invasive treatment. Participants described different experiences from multiple perspectives, including their medical history, age, breast size and emotional response to treatment. Younger women spoke of being faced with decisions about fertility; meanwhile supporting others, such as putting on a brave face for their children, was a feature for some. Although one participant reported her experience of radiotherapy as a positive one, another described having been 'mutilated, poisoned and irradiated.'

Subtheme: patient preparation

Some participants had difficulty absorbing radiotherapy information provided to them due to its timing pace and volume. Often leaflets were stored away at home unread. Although some felt under pressure to read it, they had difficulty distinguishing 'essential' information, knowing what questions they should ask about treatment, and whom to ask. Meanwhile some participants had found information independently and gained support from talking to other patients.

The whole journey is hard

Participants spoke of the profound physical and psychological impact of other aspects of their cancer treatment upon the experience of radiotherapy; worsened by the severity and pace of procedures. Terms used to describe this included *traumatic*, *relentless*, *brutal*, and *horrific*. Participants reported adjusting to and grieving for a changed body alongside dealing with radiotherapy.

Figure 1. A range of participant quotations from the workshop discussion.

"Radiotherapy will be a breeze"

Women were often given the impression that radiotherapy would be a 'breeze' compared to chemotherapy. Women spoke of being required to hold their arm in a position that for many was extremely painful due to sensitive tissue and nerve endings after surgery/chemotherapy. Having to be marked with permanent tattoos was often unwelcome and sometimes a 'massive' issue, acting as a permanent reminder of treatment for cancer. The whole radiotherapy experience was perceived as clinical and alien.

At the end of treatment many women felt abandoned or 'spat out'. The lack of a named worker to approach with concerns meant that symptoms which may be treatment side effects were not routinely addressed.

Understanding positioning and environment

Lying supine on a hard surface in a cold room was unpleasant, and sometimes worsened by hot flushes leaving participants feeling chilled. This position offered a poor view of procedures so participants felt vulnerable and exposed. These feelings were exacerbated by having to come to terms with a changed body shape post-surgery at a time when they were required to expose their breast area for radiotherapy. Being physically maneouvered on the treatment

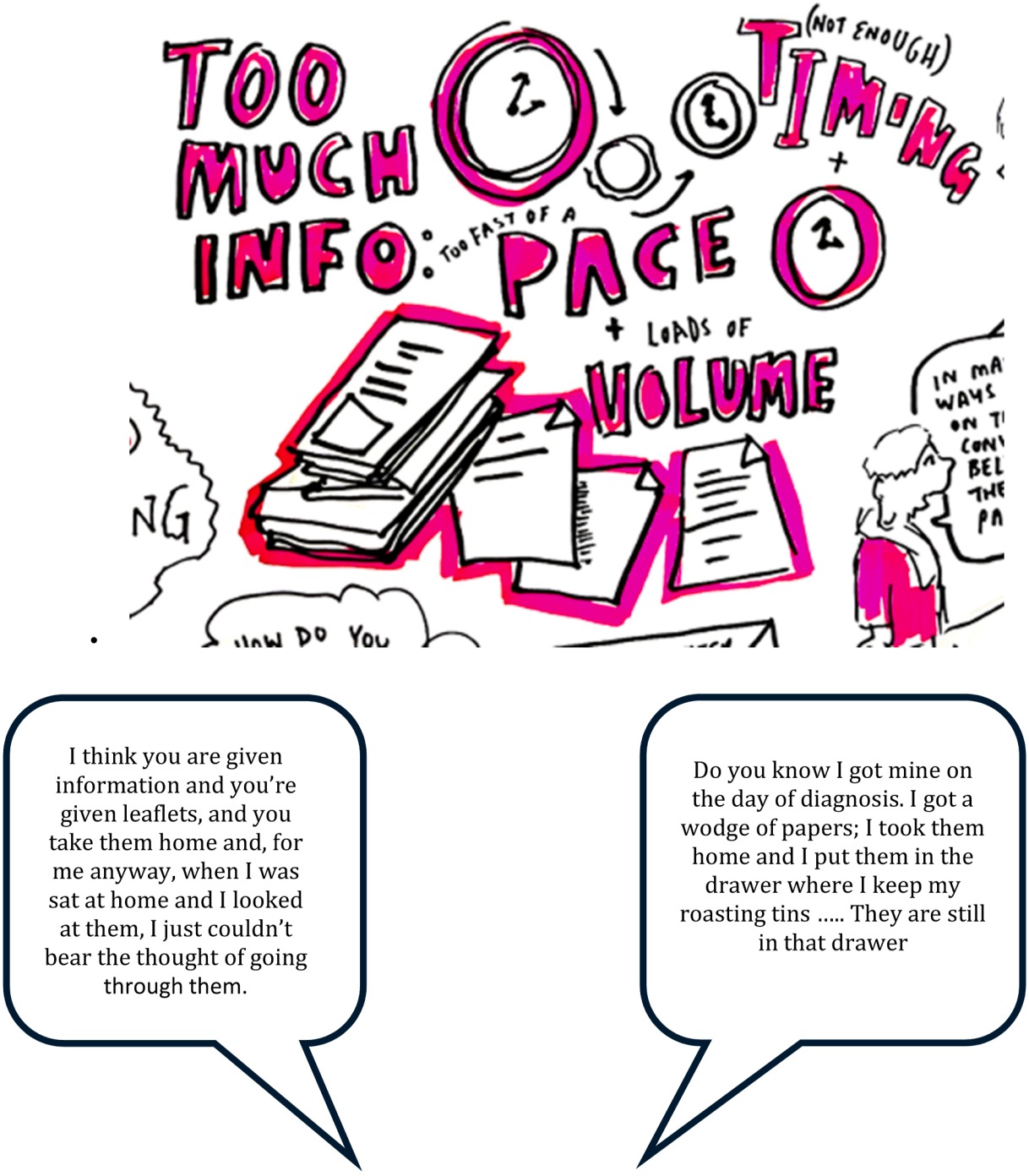

Figure 2. Information and Information leaflets.

couch, sometimes by male treatment staff, was difficult for some. Several participants struggled to raise their arms using supine radiotherapy wingboards, with words such as 'excruciating' and 'painful' being used to describe the arm position. Some spoke of remaining uncertain throughout their treatment that their arms - or indeed their body - were in the correct position. In addition, they expressed anxiety about the potential for radiation damage to the heart or lungs if they were unable to stay still.

Worst radiotherapy service

This theme arose from targeted questioning of participants about what they envisaged a worst radiotherapy service would look like and largely drawn from participants reported negative experiences (listed in Table 2).

Don't give patients any choice:

Participants generally lacked control before and during radiotherapy. Although there appeared to be a process offering participants a choice about whether to receive radiotherapy, there seemed to be an assumption that patients would accept it. This removed the opportunity to have patients' concerns addressed. Another instance was a reported lack of choice about arm positioning during treatment, even when feelings of distress and discomfort had been voiced.

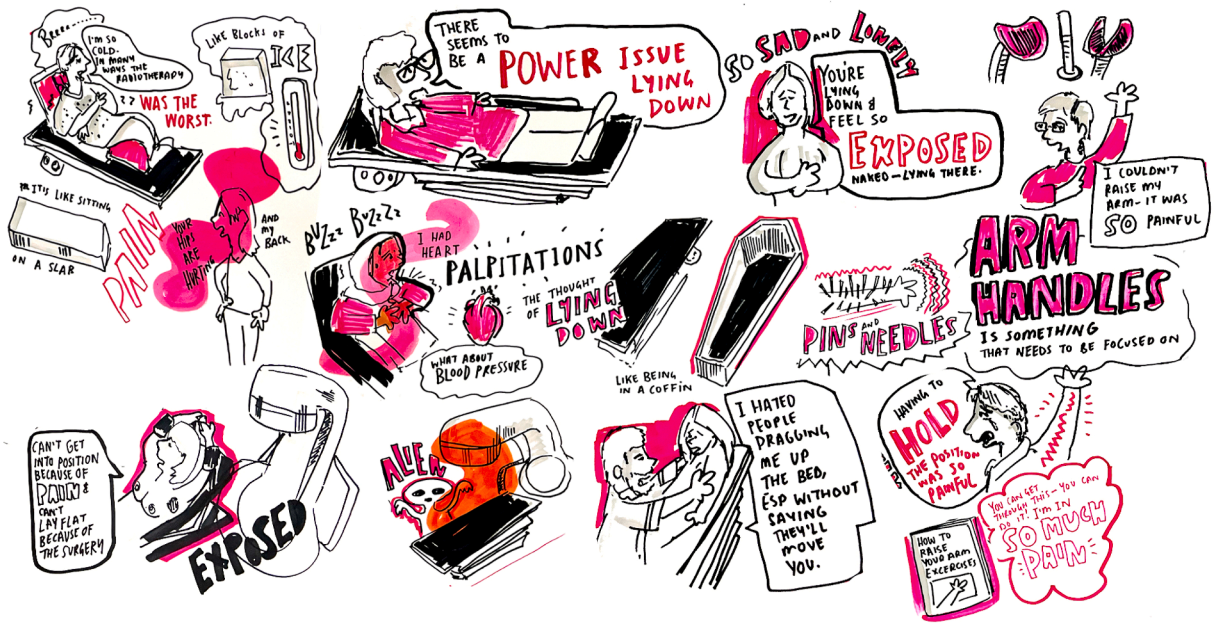

Figure 3. Patient experiences of positioning for supine radiotherapy.

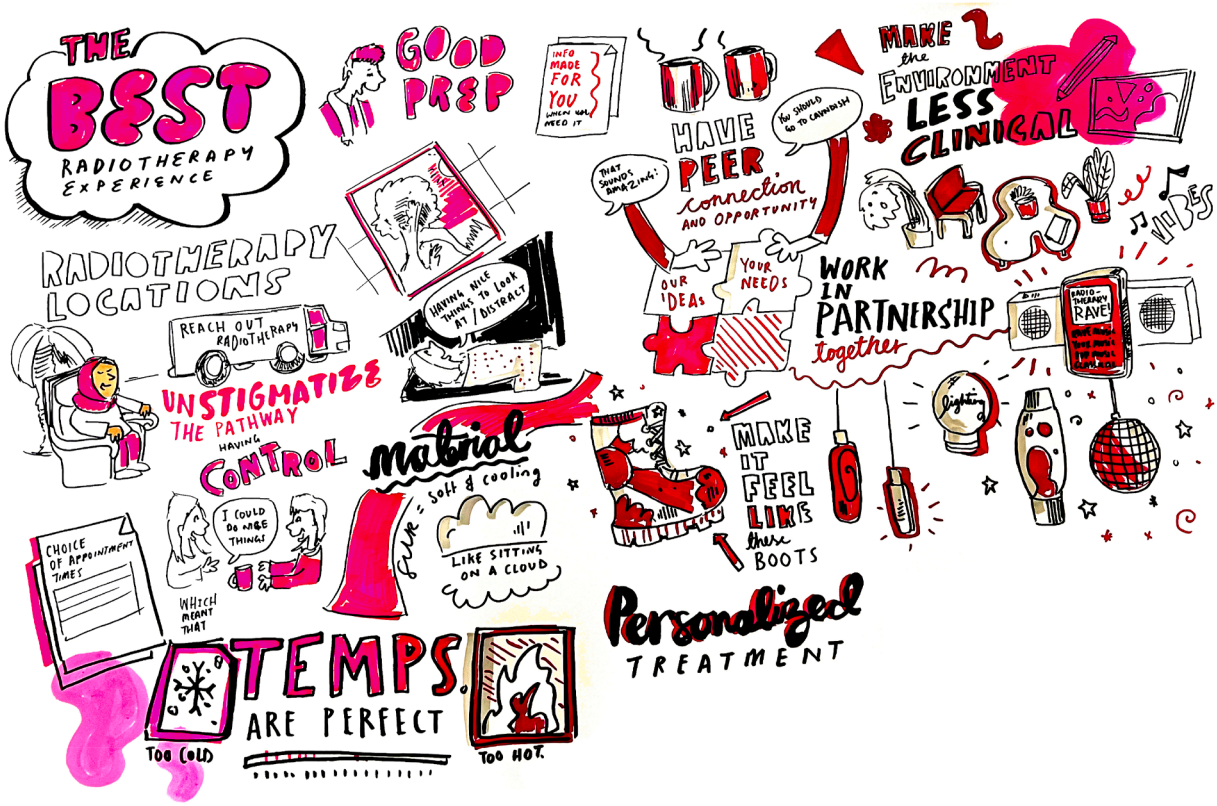

Figure 4. Participants views on how to improve the experience of radiotherapy for a breast cancer diagnosis.

Give patients incomplete information:

There were occasions when participants would have benefited from improved communication from staff, such as to alert them to the presence of male staff or the need for handling to make bodily adjustments in preparation for radiotherapy. However, this seemed a part of the perceived 'conveyor belt' of radiotherapy, with one participant commenting that patients can only be treated as a 'number' due to the volume of patients.

There was a perceived lack of consistency in the information supplied to participants: for instance, written guidance on Deep Inspiration Breath Hold (DIBH)techniques was not universally provided.

Table 2
Participants' perceptions of what would constitute the worst radiotherapy experience (in no specific order).

1	Abandon the patient
2	Don't allocate a key worker
3	Don't explain enough about radiotherapy dose and fractionation
4	Don't give patients any choice
5	Don't give patients time to process what is happening before making a decision
6	Don't prepare patients for what is about to come
7	Don't share the load of decision-making with the patient, make them feel they have to decide on their own
8	Don't tailor information to the individual
9	Give information at a rapid pace and lots of it
10	Give patients incomplete information
11	Give patients lots of information at the wrong time
12	Give the patient responsibility for decision-making without information/knowledge
13	Just give patients leaflets without any human translation
14	Make radiotherapy traumatic
15	Make the arm positioning difficult and painful
16	Make the bed really cold
17	Make the patient attend a cancer hospital for radiotherapy
18	Make the patient feel like they are on a conveyor belt
19	Make the patient's skin really sore
20	Make the positioning time really long
21	Make women lie naked when they feel they are in a different body
22	Position patients in an unnatural position
23	Send patients a letter from a health care professional explaining the breast cancer journey when they have never experienced it
24	Stereotype the patient
25	Tell the patient radiotherapy is a breeze after chemotherapy.

Table 3
Elements of the best envisaged radiotherapy experience.

	Key Elements
1	Have an accessible radiotherapy centre in the community
2	Allow the patient choice of in-room music
3	Give patients a key or named worker or radiographer they can go to
4	Give patients something positive (or distracting) to look at during treatment
5	Give people choice around the time of day they have their radiotherapy
6	Give people some control
7	Have some continuity between Linear accelerator rooms
8	Make it easy for people to get to radiotherapy
9	Make sure those that need it have physiotherapy for arm positioning
10	Make the environment less clinical
11	Provide opportunities for peer support where needed
12	Provide patients with details of the extra services available outside to support them
13	Have Radiographers providing information and support as treatment progresses in a paced fashion
14	Work in partnership with patients to help them prepare for radiotherapy

Make radiotherapy traumatic:

Elements of the environment were evidently disturbing for some participants. Radiotherapy equipment was described as 'alien' and this was compounded by being faced with shelves of moulded masks for patients being treated for a head and neck cancer.

Make the bed and the environment very cold:

Participants reported that the experience was uncomfortable as the treatment room was cold and the bed was hard; furthermore, these aspects made it harder to remain still for the required length of time.

Position patients in an unnatural position:

Conventional supine radiotherapy support structures (such as wingboards) were typically of a standard size with relatively little accommodation for different anthropometry, e.g. variable head size or arm length, making it uncomfortable for some patients to obtain a position in which to lie still. This was made worse by dealing with pain and sensitivity from previous treatments.

Best radiotherapy service

This theme emerged as participants were asked specifically about what they imagined the qualities would be of the best radiotherapy service.

Patient comfort is reflected in several of the suggestions (see Table 3). They include making the environment less clinical and more welcoming; and creating a personalised experience for patients such as allowing them to choose the in-room music or scenes of nature in their eyeline. Enabling patients to choose the time of day for their appointments was perceived as providing an element of control. In addition, optimising arm comfort by providing patients with access to physiotherapy or exercises to promote arm flexibility was advocated.

Ways to empower patients included providing individually tailored patient support and information; and offering a named contact for advice. Suggestions encompassed guidance about how to practice for DIBH to reduce patients' anxieties about doing this correctly during treatment, skin care and buying appropriate bras; advice about sources of wellbeing support; and specialist support for help with decision making about issues such as fertility. Other suggestions included dealing with skin soreness, regaining strength, handling ongoing pain, managing weight gain, returning to work, and coping with the psychological impact of the whole journey.

For participants in this study, peer support was evidently of great benefit. Information provided in person was perceived as optimum. Participants appreciated being given clear explanations and a kind attitude from staff. Moreover, striving for consistency by providing the same team of therapeutic radiographers (TRs) was seen to promote a good patient-clinician relationship.

Participants' suggestions for upholding patient dignity included being treated quickly once changed into a gown; and keeping covered those areas of the body that did not need to be exposed for treatment.

Before participants trialled the radiotherapy chair, overall the upright position was perceived to have benefits over supine radiotherapy, such as feeling more in control, having a better view of the process, feeling less vulnerable, and feeling more relaxed. Participants speculated whether such a chair could be more mobile and potentially provide treatment in community settings, helping to demystify the process, particularly for women from ethnic groups where cancer may be a taboo subject.

Participants strongly advocated for more women to be involved in radiotherapy equipment design processes, to ensure that their needs were met (Fig. 3). Physical accessories such as knee supports were felt to promote more comfortable positioning.

Trials of the upright radiotherapy chair

Nine of the ten participants undertook 10-min appointments on the demonstration version of the upright patient positioner (the tenth participant needed to leave early). A screening checklist revealed seven of the nine participants reported at least one of the following ailments: muscular tension sometimes affecting the nerves, peripheral neuropathy, post-surgery soreness under the arm, lymphoedema, cording in the ipsilateral arm, pain in the ipsilateral arm and chest wall, joint pain and stiffness following treatment (including in the finger joints, elbows and shoulders), pins and needles in the wrists and fingers. Two of the nine volunteers reported having no baseline arm, shoulder or hand issues. The participants' free comments and questionnaire answers

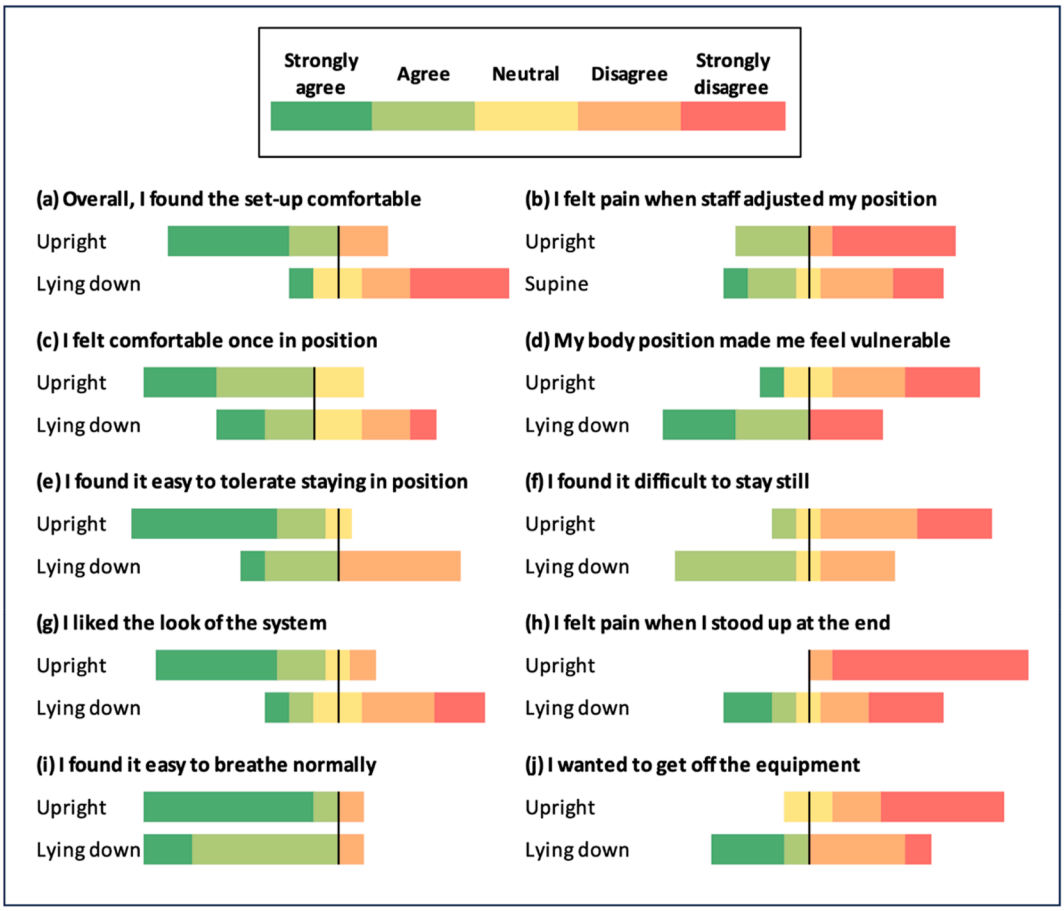

Figure 5. Questionnaire results for participants' experiences (n = 9) with (i) the upright patient positioner used in this study, and (ii) lying down positioning, as experienced during the participants' radiotherapy.

Table 4
Follow-on questionnaire results gauging overall views on upright versus supine positioning (n = 7 participants responded to this follow-on survey).

	With upright positioning	Lying down positioning	Not sure
Do you think that you would feel less emotionally vulnerable/more empowered…	71 %	14 %	14 %
Do you think you would feel a greater social connection with the radiation therapists…	100 %	0 %	0 %
Which radiotherapy treatment position do you think you would have preferred overall?	86 %	14 %	0 %

regarding the upright arm supports, along with photographs demonstrating their arm and hand positions, greatly facilitated iterative re-design of the prototypes.

Results from the questionnaires are included in Fig. 5 and Table 4. Overall, upright positioning was viewed favourably by participants. For example, when considering the statement "Overall, I found the set-up comfortable", 77.8 % of participants (n = 9) were in agreement, compared to only 11.1 % for the conventional, supine treatment position (Fig. 5(a)). When considering the statement "My body position made me feel vulnerable ", 66.7 % agreed with this statement for their supine treatment, compared to only 11.1 % for their upright trial ((Fig. 5(d), n = 9). When asked "which radiotherapy treatment position do you think you would have preferred overall" in the follow-on survey, 86 % responded "upright" and 14 % responded "lying down" (n = 7). Despite the overall highly positive response towards upright positioning, it was highlighted by participants that[1]: some women may feel more "on show" and body conscious if required to be topless upright, compared to lying down (with participants noting that a treatment bra could allay those concerns)[2]; lowering the CT scanner over the chair could lead to feelings of claustrophobia (the CT ring was not included in the demonstration version of the upright radiotherapy chair); and[3] there were concerns over how well the slow rotation of the clinical version of the chair (one revolution per minute) would be tolerated, as this was not tested by the participants (See Fig. 6 for an example of the chair set-up).

Discussion

The aim of this study was to explore if contemporary experiences of breast cancer radiotherapy (in the supine position) validates earlier published data,[10] and consider ways in which the pathway could be improved. The team also sought to explore how upright radiotherapy might offer a different experience for patients. Participants' feedback on prototype arm supports informed the development of upright radiotherapy accessories, in a way which will improve physical and psychological comfort for future patients. Overall, factors promoting patient empowerment and

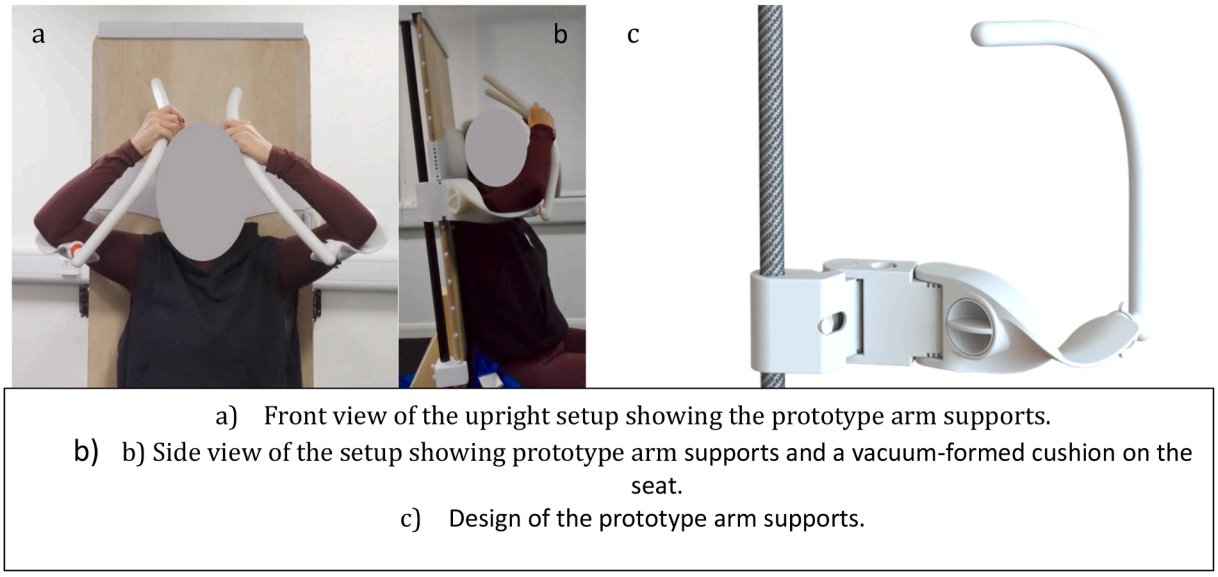

Figure 6. Images to show the upright set-up considered. (The arm supports shown are early-stage prototypes designed by Leo Cancer Care, which have since been refined, in part based on feedback from the participants in this study.).
a) Front view of the upright setup showing the prototype arm supports.
b) b) Side view of the setup showing prototype arm supports and a vacuum-formed cushion on the seat.
c) Design of the prototype arm supports.

improving physical or psychological comfort were key areas of interest.

Increasing patient empowerment

There is a need to address patients' continued feelings of disempowerment resulting from a lack of choice, poor information provision and limited control. Although participants in a large survey (n = 653)[17] reported overall satisfaction with treatment, there is room for improvement in patient information at different points in the pathway. For example, the potential for increased anxiety caused by online information which may be unreliable or inappropriate[18] could be mitigated by supplying accurate and relevant information and signposting to trustworthy sources. There is also a clear opportunity to address the perceived lack of support and information at treatment end.[19]

Improving physical and psychological patient comfort

The results from this study are consistent with findings of previous research relating to women's feelings of vulnerability, loss of dignity and fear.[10] The theme *radiation works in mysterious ways* reported by Schnur and colleagues[20] reflects the alien experience described by some participants in the present study. Likewise, anxiety caused by the need to remain still during treatment to reduce the risk of radiation damage to the heart or lungs is echoed in the study by Schnur and colleagues'.[20] Perhaps unsurprisingly, the significance of the relationship between patient and TR was highlighted by participants. Suggestions such as offering patients clear explanations and displaying a kind attitude are supported by other research findings, alongside offering visual and/or auditory forms of distraction during treatment.[11,21–23] The challenges to embedding a patient-centred approach within a highly technical, unfamiliar, and protocol-driven environment have been noted before.[24] The technical demands of the task are critical, but they need not prohibit TRs from interacting with patients, since meeting patients' needs for emotional comfort will promote a positive experience. However, this may be more challenging to achieve for supine positioning, and upright positioning may provide an opportunity for meaningful radiographer-patient engagement during set-up where the patient can see non-verbal radiographer communications, or have the ability to lip read instrctions from radiographers; particularly of relevance to patients with hearing difficulties. While individualised care is advocated for all patients, the specific cultural needs of women from different ethnic groups, and the communication needs of those who have intellectual disabilities[25] require particular attention.

It has been suggested that achieving a physically comfortable position for the patient could improve treatment accuracy,[11] hence the benefits extend beyond enhancing patients' wellbeing during the delivery of treatment. The findings of this study add to the limited evidence on patients' views on positioning and comfort throughout the radiotherapy pathway and include suggestions for improving the comfort and positioning of arm supports and hand grips. Our study found that nerve and tissue damage resulting from previous treatment contributed to pain and discomfort; similarly others have commented on the negative impact of pre-existing health issues.[11]

Overall, the option of upright radiotherapy was broadly preferred by participants who had experienced radiotherapy for breast cancer, consistent with a previous study on this topic.[12] Limitations of both studies are that[1] innovation is "often regarded as universally positive"[26,2] upright radiotherapy innovators also contributed to the research (in this case TU, SI, JN, RT) and[3] the sample sizes are small. To minimise the potential for bias in this study, questioning was primarily performed by the academic team: JU, SH, SS and HP rather than the industrial researchers. Throughout the day, participants emphasised their desire to draw upon their lived experience, giving honest feedback to try to improve radiotherapy for future patients. They also welcomed the opportunity to interact directly with the industrial researchers and contribute to co-design of the arm supports.

Concerns were voiced regarding potential claustrophobia from lowering the CT scanner bore over the upright treatment chair, plus patient tolerance of the slow chair rotation that would be implemented clinically (one revolution per minute). These were not tested in this study and are recommended as subjects for

further research. Some participants also expressed concern that, if treated topless, they would feel more exposed positioned upright compared to lying down. The need or otherwise for breath hold for upright breast radiotherapy, and the associated comfort, was also raised. Finally, several participants emphasised that treatment quality, rather than body position, would remain their primary concern.

The sample of participants was predominantly White. Perspectives of women from other ethnic groups are essential to gain a better understanding of their needs. The deep distress described by participants in findings of a small qualitative study by Habibullah and her colleagues[27] demonstrates the significance of cultural attitudes to cancer and its treatment.

Conclusions

This study highlights the potential benefits of upright radiotherapy for patients diagnosed with breast cancer. By reinforcing findings from previous research on the emotional and physical experiences of supine radiotherapy, the results contribute valuable insights into patient-centred care. The results suggest that exploring upright positioning could play a significant role in improving both comfort and psychological well-being, offering a meaningful direction for future innovation and clinical practice in radiotherapy.

Ethics approval and consent to participate

Ethical approval for this study was obtained from Sheffield Hallam University ethics committee (ER62921756).

Written informed consent was obtained for anonymised patient information to be published in this article.

Availability of data

Data required for this study may be made available by the author(s) upon reasonable request.

Author contributions

JU: Methodology, validation, formal analysis, investigation, resources, data curation, writing original draft, writing-reviewing and editing, visualisation, project administration.

SI: Methodology, validation, investigation, resources, writing-reviewing and editing, visualisation.

JN: Conceptualisation, methodology, validation, investigation, writing-reviewing and editing, visualisation.

RT: Conceptualisation, methodology, validation, investigation, resources, writing-reviewing and editing, visualisation.

TU: Conceptualisation, methodology, validation, formal analysis, investigation, resources, data curation, writing-reviewing and editing, visualisation, supervision, project administration, funding acquisition.

SS: Investigation, resources, visualisation.

SH: Validation, investigation, writing-reviewing and editing.

HP: Conceptualisation, methodology, validation, formal analysis, investigation, resources, data curation, writing original draft, writing reviewing and editing, supervision, project administration.

Declaration of generative AI and AI-assisted technologies in the writing process

Not applicable

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Conflict of interest statement

JU: No conflict of interest to declare.
SI: Employed by Leo Cancer Care Ltd.
JN: Employed by Leo Cancer Care Ltd.
RT: Employed by Leo Cancer Care Ltd.
TU: Employed by Leo Cancer Care Ltd.
SS: No conflict of interest to declare.
SH: No conflict of interest to declare.
HP: No conflict of interest to declare.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.radi.2025.103157.

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