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Anxiety during Magnetic Resonance Imaging of the spine in relation to scanner design and size

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Abstract

Introduction: Magnetic resonance imaging in closed-bore scanners sometimes provokes anxiety but closed-bore designs have gradually become wider and shorter. Open scanners may be easier to tolerate.

Aim: To compare patient anxiety during MRI between scanners with bore diameters of 60 cm and 70 cm, and to determine the current level of patient anxiety and experience in open scanners in a clinical setting.

Method: Consecutive patients referred for examination of the spine in 60 cm and 70 cm and one open scanners participated. Scheduling for examination in the open scanner was primarily to address patient problems with closed bores. Four established/validated questionnaires, answered before, directly after and one week after the MRI-examination were used, measuring anxiety, fear and depression.

Result: 155 patients responded to the questionnaires before and immediately after the examination. 109 responded one week later. No difference was found in the patient scores of anxiety between the 60 cm and the 70 cm scanners on the examination day. At follow-up, patients in the 60 cm bore rated their examination experience lower ($p<0.05$), compared to patients in the 70 cm bore. Patients in the open scanner rated higher levels of anxiety ($p<0.001$) before, directly after and one week after the examination, compared to closed bore scanners.

Conclusion: Scanners with a 70 cm diameter seem more tolerable than those with a 60 cm bore. Patients referred to the open scanner were more likely to express anxiety than those in the closed bore, possibly due to selection bias. Still, patient anxiety in MRI is challenging and further research required.

Keywords: Magnetic Resonance Imaging, MRI examinations, anxiety, patient care.

Introduction

Magnetic resonance imaging (MRI) is a versatile diagnostic tool which may be used to evaluate all body parts in a wide range of conditions. It is used worldwide in high numbers and the use is continuously increasing [1]. In the United States, 118 MRI-examinations per1000 inhabitants are performed annually and in Germany 136/1000 [2]. Sweden is a late adopter with 42 MRI examinations per 1000 inhabitant in 2013 [3].

If the patient has no contraindication, MRI is known to be safe and can be repeated whenever needed [4,5]. However, an investigation in the MRI tunnel is known to be an anxiety-ridden procedure for some patients. The loud noise and the long duration of the examination negatively affect patients. The enclosed environment of the tunnel is known to induce anxiety [6-10], which may affect 1-30% of patients [9,11,12]. Anxiety may result in premature termination of an MRI study as well as the patient refusing follow-up [13]. Anxiety causes unwanted motion artefact, which may preclude a correct diagnosis [14]. Worldwide, 2 million scans are aborted each year due to claustrophobia [15].

Different interventions have been suggested to reduce anxiety, such as offering psychological support or relaxation training, performing the study with the patient lying prone [16-19] or prescribing pharmacological sedation [5].

Technological advances allowing a shorter and wider bore may make future examinations less trying. Scanners with 1.5 Tesla (T) field strength dominate the market and often have a 60 cm bore. Newer scanners frequently have bores with a diameter of 70 cm. To the best of our knowledge, no one has compared patient experience examined in scanners with diameters of 60 cm and 70 cm.

A completely open design is possible but the field strength, recently up to 1.0 T, will be lower than in closed-bores, and the lower signal will negatively affect image quality. Studies

have compared anxiousness of patient suffering from increased risk of claustrophobic experience in open vs closed bore scanners, were patients in open bores have had significantly decreased anxiety [13,15]. There is a lack of studies evaluating if open configured MR systems increase patient comfort and reduce anxiety to an acceptable level in a clinical setting. Thus, it is important to determine the patient experience for possible future improvements.

Therefore, the primary aim of this study was to compare patient anxiety during MRI between scanners with bore diameters of 60 cm and 70 cm. The secondary aim was to illustrate the current level of patient anxiety and the total patient experience in an open scanners in a clinical setting.

Methods

Scanners

The study was performed at three different MRI sites, using three different scanning systems: Siemens ”Avanto 1.5T” with 60 cm tunnel (Siemens Healthcare, Erlangen Germany), the wider tunnel was “GE 1.5 T 450” (GE Healthcare, Milwaukee, Wisconsin, USA) with a 70 cm bore diameter and the open scanner was “Panorama 1.0 T” (Philips Healthcare, Best, the Netherlands),

Patients

Consecutive patients referred for MRI of the spine were asked to participate. During examinations the patients were placed on a spine coil with no surface coil over the patient. All patients had an alarm and they were in constant verbal contact with the radiographer during the examination. The investigations were performed between August 2015 and May 2017. The open scanner received a dominant proportion of referrals where patients had asked specifically to be examined in an open design. Inclusion criteria were: referral for MRI of the

spine to diagnose possible disc hernia; age 18 years or older; ability to speak and write the Swedish language, and lack of contraindications for MRI. An invitation to participate in the study was included in the scheduling letter for the examination.

Measures

Four different qustionnaires, used in earlier studies were patient anxiety in connection with MRI has been evaluated [20,21] were used to characterize the patients. *Spielberger State and Trait anxiety – state* (STAI-S), STAI-S, measures state (situational), 20 items [22]. *Hospital Anxiety and Depression scale* (HAD) is developed in two parts, one measuring anxiety and one depression, seven items each [23]. *The Magnetic Resonance Imaging- Fear survey schedule* (MRI-FSS), consists of nine statements from the Fear Survey Schedule [24] defined by Lukins et al. [25]. *The Magnetic Resonance Imaging- Anxiety Questionnaire* (MRI-AQ) is divided in two factors; "anxiety" (12 items) and "relaxation" (three items) [20]. All questionnaires are well known. STAI, HAD and MRI-AQ have previously been validated. [20,22,23].

Single items: Patient "experience" and "worry" during the examination were graded on a ten-point scale by patients and staff independently. The items have been used in previous MRI-study [21]. All staff members had extensive experience in performing MRI and were trained by the lead author how to use the assessment scale before the start of the study. Patients who chose to participate responded to questionnaire before (HAD, MRI-FSS, STAI-S), immediately after (MRI-AQ, MRI-FSS, Single items "worry" and experience") and one week after the examination (MRI-AQ, HAD, MRI-FSS, Single items). The staff ranked their perception of patient experience and worry throughout the examination on a ten-point scale. Each questionnaire took about ten minutes to answer.

Ethical considerations

The study was approved by the Regional Ethical Review Board. It followed the Declaration of Helsinki [26] and the principles of Good Clinical Practice [27]. Written informed consent was obtained from all participants after a full explanation of the study procedure. The patients were informed that study participation was voluntary and that they could withdraw from participation whenever they wished without negative consequences.

Data analyses

The calculation of sample size was based on the prevalence of anxiety in patients undergoing MRI examinations in previous research using STAI. Based on an expected effect size of 40%, an alpha set at 0.05 and a power of 0.80, a sample size of 50 participants in each study arm was sufficient for the study.

Descriptive statistics was used to present participants characteristics. Parametric data was expressed as mean ± standard deviation (SD) and Student´s t-test was used for test of significance.

When data on an ordinal scale level had a skewed, non-Gaussian distribution according to the Kolmogorov-Smirnov test, median and quartiles were used. For comparison of data collected directly after the examination and one week later, the Wilcoxon signed rank test was used. The Mann–Whitney U-test was used for comparisons between study groups and a Chi Square test was used for comparison between those who answered the questionnaire once or twice. A two-tailed p-value of ≤0.05 was regarded as statistically significant.

Data was analyzed using SPSS version 25 (IBM, New York, USA).

Result

Participants

174 patients referred for examination in the 60 or 70 cm scanners were asked to participate. 106 accepted and answered the questionnaires before and after the examination, resulting in a response rate of 61%. 81 of the 106 also answered the questionnaires a second time, one week after the examination. For the open scanner 62 patients were asked to participate, 49 accepted, response rate 79%. 28 answered a second time, one week later (fig 1).

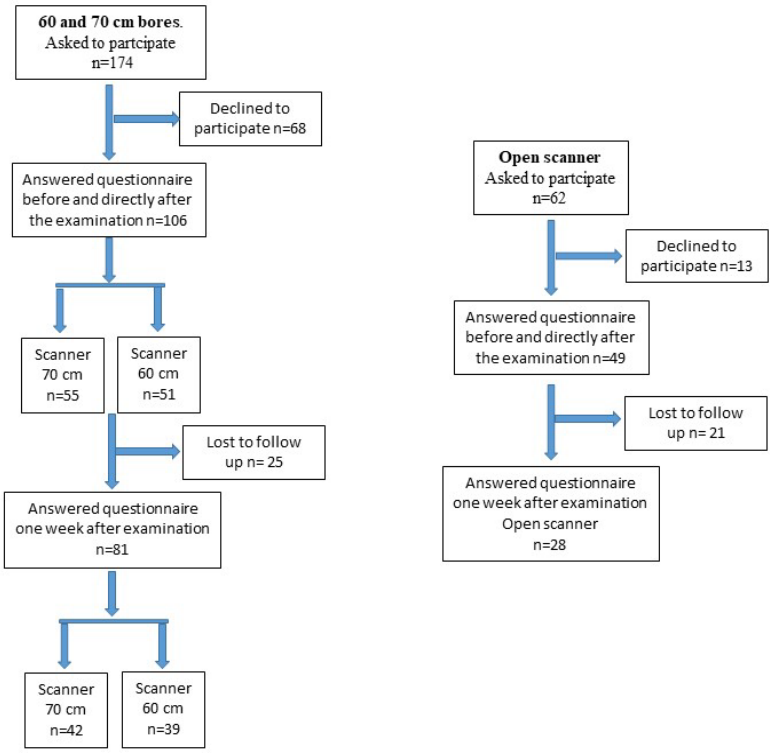

Figure 1, Flow diagram

Age and gender did not differ between those who participated (55.5±12.0 years, female n=81 and male n=74) and those who did not (52.4±13.0 years, female n=51 and male n=30). Significantly higher level of anxiety was found in the group who answered the questionnaires once (HAD-A p=0.005, for MRI-FSS p=0.006, for MRI-AQ p=0.013) compared to those who also answered the questionnaire one week later.

There was no significant difference regarding age between the three groups. As for gender, a significantly higher proportion of females were referred to the open scanner compared to the 60 cm and 70 cm scanners (p=0.001) (Table 1).

Table 1. Distribution of sample size, gender, age and scanners

Variables		70 cm (n=55)	60 cm (n=51)	Open (n=49)	Total
Agreed to participate, *n*		55	51	49	155
Gender male/female, *n*		37/18	24/27	14/35	75/80
Age in years mean±SD (min-max)					
	All	56.4± 9.8 (29-72)	54.9 ± 14.4 (18-81)	54.9± 11.6 (26-77)	55.5±12.0 (18-81)
	Male	57.4±10.1 (29-72)	54.8±15.7 (18-81)	51.4±11.9 (35-76)	55.4 ±12.5 (18-81)
	Female	54.5±8.9 (37-69)	55.0±15.7 (23-78)	56.2±11.4 (26-77)	55.4 ±11.5 (23-78)

n=number of participants

Before the examination

No difference was found regarding anxiety, measured with HAD A, MRI-FSS, STAI-S, between patients referred for examination of the spine in the 60 cm or the 70 cm bore scanners. The patients in the open scanner scored significantly higher levels of anxiety than those in the closed bores. No difference was found between the groups regarding depression (HAD-D) (Table 2).

Table 2. Result from questionnaire answered before the examination

	70 cm [a] (n=55)	60 cm [a] (n=51)	p-value 70/60 [b]	Open [a] (n=49)	p-value 70/open [b]	p-value 60/open [b]
HAD A	5 (3-7)	3 (1-8)	0.291	7 (5-9)	**0.001**	**0.001**
HAD D	3 (1-5)	2 (0-7)	0.336	3 (1-6.5)	0.474	0.088
MRI-FSS	14 (11-18)	12 (10-17.25)	0.204	19 (16-26.5)	**< 0.001**	**< 0.001**
STAI-S	35 (27-44)	32 (26-46)	0.106	43 (35.5-48.5)	**0.003**	**< 0.001**

HAD A= Hospital Anxiety and Depression scale Anxiety, Hospital Anxiety and Depression scale Depression, MRI-FSS=magnetic Resonance Imaging-Fear Survey Schedule, STAI-S= Spielberg State and Trait Index-State, [a] Median (interquartile range), [b]= Mann Whitney U-test, n=number of participants

Immediately after the examination

Immediately after the examination, no difference was found between patients examined in the 60 cm or 70 cm scanners. Patients examined in the open scanner experienced significantly higher levels of anxiety measured with all rating scales (Table 3).

Table 3. Result from questionnaires answered directly after the examination

	70 cm [a)] (n=55)	60 cm [a)] (n=51)	p-value 70/60 [b)]	Open [a)] (n=49)	p-value 70/open [b)]	p-value 60/open [b)]
MRI-AQ	20.5 (18-23.25)	20.5 (18-26.25)	0.433	29 (26-34)	**< 0.001**	**< 0.001**
MRI-AQ Anxiety	16 (15-17.25)	16 (15-20.5)	0.215	23 (20-27.5)	**< 0.001**	**< 0.001**
MRI-AQ Relaxation	4 (3-6)	4 (3-6)	0.805	6 (6-9)	**< 0.001**	**< 0.001**
Patient Worry*	1 (1-2)	1 (1-2.25)	0.470	4 (2-6)	**<0.001**	**< 0.001**
Patient Experience*	1 (1-2)	1 (1-2.25)	0.163	2 (1-5)	**< 0.001**	**0.018**
STAI-S	27 (23-33.75)	28 (23-39)	0.914	35 (27-43.5)	**0.003**	**0.003**

MRI-AQ= Magnetic Resonance Imaging-Anxiety Questionnaire, STAI-S = Spielberg State and Trait Index-State. *Single items patients rated their worry and experience on a ten-point scale. [a)] = Median (interquartile range) [b)] = Mann Whitney U-test, n=number of participants, n=number of participants n=number of participants. Significant values in bold.

The staff evaluation on single items of patient "worry" and "experience" showed significant differences between all groups. Patients in the 70 cm bore reported the lowest level of worry, whereas high worry was experienced in relation to the open scanner (Table 4). When patient and staff ratings on the single items experience/worry were compared, the greatest differences were seen in patient "worry" in the open scanner, where the patients rated their "worry" worse than the staff did.

Table 4. Staff ratings on single items of patient experience and worry for the three scanners

	70cm[a)] (n=55)	60 cm [a)] (n=51)	p-value 70/60 [b)]	open [a)] (n=49)	p-value 70/open [b)]	p-value 60/open [b)]
Worry	1 (1-1)	2 (1-3)	**<0,001**	3 (1-6)	**<0,001**	**0.006**
Experience	1 (1-1)	2 (1-3)	**<0,001**	2 (1-3)	**<0,001**	0,396

[a)]=Median (interquartile range), [b)]=Mann Whitney test, n=number of participants

One week after the examination

After one week, the patients examined in the 70 cm bore rated their experience of the examination significantly ($p<0.001$) better than patients in the 60 cm bore. Patients examined in the open scanner experienced significantly higher levels of anxiety measured with all scales (Table 5).

Table 5. Questionnaires answered one week after the examination

	70 cm (n=42) [a)]	60 cm (n=39) [a)]	p-value 70/60 [b)]	Open (n=28) [a)]	p-value 70/open [b)]	p-value 60/open [b)]
MRI-AQ	18.5 (16-23)	19 (16-26)	0.578	30 (24-38)	**<0.001**	**<0.001**
MRI-AQ Anxiety	14 (12-16)	14 (13-19)	0.292	23.5 (18.25–30.75)	**<0.001**	**<0.001**
MRI-AQ Relaxation	5 (3-6)	6 (3-7)	0.796	7 (6-9.5)	**0.001**	**<0.001**
Patient Worry*	1 (1-2)	1 (1-3)	0.097	4 (3-6)	**<0.001**	**<0.001**
Patient Experience*	1 (1-2)	2 (1-3)	**0.025**	4 (2-6)	**<0.001**	**0.008**
HAD A	4 (1-6)	1 (0-7)	0.208	7 (4-9.75)	**0.003**	**0.001**
HAD D	2 (0-4.25)	1 (0-4)	0.268	3 (1-5.75)	0.215	**0.028**
MRI-FSS	14 (10-17)	13 (10-17.5)	0.825	22 (14.75-26.75)	**<0.001**	**<0.001**

MRI-AQ= Magnetic Resonance Imaging-Anxiety Questionnaire, HAD A = Hospital Anxiety and Depression scale Anxiety, Had D = Hospital Anxiety and Depression scale Depression, MRI-FSS Magnetic Resonance Imaging-fear survey Schedule. *Single items patients rated their worry and experience on a ten-point scale. [a)] = Median (interquartile range), [b)]= Mann Whitney U-test, n=number of participants

Comparisons before the examination, directly after and one week later

Only patients who answered the questionnaires twice were included (Fig 1). Patient anxiety during MRI (MRI-AQ) was reported on a lower level at one week after the examination, compared with directly after, for those examined in the 60 cm or the 70 cm scanner. Regarding Single items, (worry/experience) patients rated their worry and experience on a ten-point scale. For the factor “relaxation”, no temporal difference was found in the 60 cm group, while the patients in the 70 cm scanner judged “relaxation” during examination as worse after one week. The group examined in the open scanner, rated “anxiety” and “relaxation” without change after one week. The patient ratings of “experience” and “worry” showed no difference over time for the 70 cm scanner. Patients examined in the 60 cm bore

scanner rated both "experience" and "worry" as worse one week after the examination. The group in the open scanner judged their "experience" after one week as worse compared to immediately after, while no differences were found for worry (Table 6).

Table 6. Comparison between patient ratings of MRI-AQ, experience and worry directly and one week after the examination. Only patients answering the questionnaires both directly after and one week after the examination were included.

	70 cm scanner (n=42)			**60 cm scanner** (n=39)			**Open scanner** (n=28)		
	Directly after[a)]	One week after [a)]	p-value [b)]	Directly after [a)]	One week after [a)]	P-Value [b)]	Directly after [a)]	One Week after [a)]	p-value [b)]
MRI-AQ Total	20 (18-22)	18 (16-22)	**0.005**	21 (18-26)	19 (16-26)	**0.013**	31 (26-36)	28 (24-37)	0.231
MRI-AQ Anxiety	16 (15-17)	14(12-15.25)	**>0.001**	16 (15-20)	15 (12-19)	**0.005**	24 (20-29)	21.5 (18-29.75)	0.111
MRI-AQ Relaxation	4 (3-6)	5 (3-6)	**0.033**	4 (3-6)	4 (3-6)	0.350	6 .5 (5.25-9)	7 (6-9)	0.598
Experience*	1 (1-2)	1 (1-2)	0.510	2 (1-2)	2 (1-3)	**0.048**	3 (1-5)	4 (2-6)	**0.009**
Worry*	1 (1-2)	1 (1-2)	0.221	1 (1-2)	1 (1-3)	**0.017**	4 (2-6.75)	4 (3-6)	0.580

MRI-AQ- Magnetic Resonance Imaging-Anxiety Questionnaire, Total-the total instrument MRI-AQ, anxiety- the factor anxiety, relaxation – the factor relaxation *Single items patients rated their worry and experience on a ten-point scale. [a)]=Median (interquartile range), [b)] Wilcoxon signed-rank test. n=number of participants

Anxiety (STAI-S) decreased ($p<0.001$) in all three groups directly after the examination compared to before. When compared before and one week after the examination, no differences were found regarding anxiety (HAD-A), depression (HAD-D,) and fear of situations related to MRI examinations (MRI-FSS).

Males and females

In the following aspects, women showed significantly higher anxiety level compared to men on the day of the examination: Experience ($p=0.022$), worry ($p=0.004$, MRI-FSS ($p> 0.001$), MRI-AQ - total questionnaire ($p>0.001$), MRI-AQ Anxiety ($p=0.001$) and MRI_AQ Relaxation ($p>0.001$). One week after the examination, women still showed higher anxiety level than men: Experience ($p=0.021$), worry ($p=0.014$), MRI-FSS ($p=0.001$), MRI-AQ questionnaire ($p=0.002$) and MRI-AQ Relaxation ($p=0.02$).

Discussion

Several previously published studies investigate the effect of the tunnel diameter on image quality. However, there is little recent quantitative empirical research related to patient anxiety and experience in clinical practice in different scanners. This study aimed to illustrate patient anxiety in two scanners with bore diameters of 60 cm and 70 cm, and also as a secondary aim the patient condition in an open scanner. This research provides valuable information for professionals interested in improving the wellbeing of their patients.

All patients experienced less state anxiety (STAI-S) after the examination than before the procedure, probably as a sign of relief after the completed investigation. As single items, "experience" and "worry" showed no difference immediately after compared to one week after the examination for the 70 cm group. The group examined in the 60 cm bore tended to rate their "experience" and "worry" worse after one week. Patients in the open scanner judged their "experience" as worse, but their "worry" was unchanged after one week. It is likely that some of the patients examined in the 60 cm bore but especially in the open scanner will experience severe anxiety if they need to have the investigation repeated. In order to avoid future complications, it is important to debrief the patient about the anxiety-provoking situation.

In a group-based comparison, patients in the 70 cm scanner recalled their "experience" of the examination more positively than did those in the 60 cm bore. The staff, who were all experienced radiographers working with MRI, also rated patient "experience" and "worry" higher (worse) for the patients in the 60 cm scanner than in the 70 cm scanner. It should be born in mind, though, that the score provided by the patient is the "gold standard".

Even if no differences were seen on the day of the examination, recall of the examination was more positive for the group in the 70 cm bore. Altogether, this indicates that the 70 cm bore is preferable for patients.

In this study we show that patients examined in the open scanner in a clinical setting, expressed high levels of pre-test anxiety which may have motivated them to ask for referral to an open design scanner. This high anxiety rating was evident also in the follow-up. Even if workers within the MR community are aware of the plight of some patients it is important to increase the awareness of referring physicians regarding patient investigative anxiety. Although examined in an open scanner they had high levels of anxiety and scored worse for generic (STAI-S, HAD-A) and specific anxiety (MRI-AQ with the factors anxiety and relaxation) and fear (MRI-FSS) before, directly after and one week after the examination as well as for the two single items about "experience" and "worry", compared to the groups in the closed bores. The staff also scored the patients "experience" and "worry" in the open scanner group as poorer than in the other two scanners. As Lang et al. we found that the most anxious patients are examined in open scanners [29]. In some previous studies, patients have displayed a higher tolerance of being scanned in an open scanner, compared to closed bores [15,30]. Nearly all patients in this study had requested to be examined there due to difficulties while being examined in a tunnel-like bore, even if claustrophobia per se was not an inclusion criterion. Referral to an open scanner could be the only way for those patients to endure a complete examination. The patients in the closed bores were recruited from a waiting list without having expressed particular wishes regarding the type of scanner.

In a previous study, when reminded one month after being examined, about 30% of the respondents experienced increased feelings of anxiety, and about one third were unwilling or hesitant to undergo a new MRI scan [31]. On the contrary, in our study, levels of anxiety decreased over time in the closed bore, but the open scanner patients maintained the same

level of anxiety one week after the examination (MRI-AQ) as immediately after the scan. Reduced anxiety over time may allow patients to undergo a new examination, if required. On the contrary, patients examined in the open scanner seem to constitute a separate group with different and extensive problems that do not resolve over time.

Compared to previous studies [15,30], the scores in the STAI-S and MRI-FSS were lower (indicating less anxiety) in the present study. In the previous studies, inclusion criteria were claustrophobia, whereas in the present study the participants were consecutive patients in clinical settings, but some had explicitly asked to be examined in the open scanner. Studies comparing the number of claustrophobic events, regardless of whether the patients were screened for claustrophobia or not, have shown that wider, shorter and open scanners are always preferred by patients, compared to more narrow scanners [15,30,32,33]. For patients with scanning anxiety the advantage of an open scanner seems to be considerable, but at a cost mainly related to decreased image quality [34]. In comparisons between open scanners and those with a closed bore, image quality is superior in scanners with a closed bore [35]. However, in retrospective evaluations, image quality has been found to be acceptable in open design scanners [36]. It is more important that the patient completes an examination with somewhat lower image quality than having an aborted study in a closed-bore scanner. The clinical MRI market is dominated by closed bores at 1.5 T followed by 3 T [37,38].

Our study confirms findings from other studies [14,39] where women express higher levels of anxiety than men.

For anxious patients, examinations in an open scanner or some kind of supporting interventions before or during the examination can be tried [21,28,29]. Even if tunnel-like scanners are produced with a wider and shorter bore, such efforts may be limited by the appearance of additional problems also in patients without anxiety in relation to MRI. Better

scan information, in the form of a video clip or an informative telephone call have shown promising results [21,40,41]. This is an easy way to make patients feel more relaxed. If patients can watch the video at home, their preparation becomes time-effective. Watching the video could also be a way to process an unpleasant experience. Extended written information has produced reduced motion artefacts in images [14]. In practice, it is the responsibility of the radiographer to take the time to prepare the patient especially since studies have shown tailored information to have a positive effect reducing motion artefacts [14,42].

The interaction between the patient and the staff should be highlighted, regardless whether the scanner is open or has a wide bore [19,43,44].

Limitations

In this study, consecutive patients were referred for MRI of the spine in one of three different MRI scanners. A randomized procedure or a procedure where the patient is their own control would have been preferable. However, the extent of cooperation and the time required to perform 3 different MRI investigations precluded such a strategy.

The study used valid and reliable instruments. To assess experience, worry and other sensation and emotions, ten-point scales have been widely used.

Body mass index (BMI) and prior patient MRI experiences, factors known to influence scanning anxiety, were not studied which may affect the generalizability of the study results. In a randomized controlled trial on claustrophobia in MRI, patients with prior negative experiences from MRI did not show significantly higher BMI or higher pre-imaging anxiety (STAI) than patients without those experiences [15].

The patients who rated the highest levels of anxiety immediately after the scan showed clearly lower participation rate at the second administration of the patient questionnaire. If they had participated in the delayed questionnaire, the result could have been different. The

response rate at the follow up, one week after examination was completed by 80% of the study participants for the closed bore and 57% for the open scanner

Patients examined in the open scanner were used as a backdrop to our closed bore study groups: they expressed significantly higher anxiety and had to a large extent expressed a preference to have an open bore scan. Furthermore, patients in the open scanner showed a completely different profile with high level ratings of anxiety and low ratings of relaxation which did not change over time. Their only way to cope with a scan was to be examined in the open scanner.

Conclusion

When patient experience of the MRI examination in the 60 cm and 70 cm bores was compared it was similar immediately after the examination. However, patient recall of the examination was more pleasant for those examined in the 70 cm bore scanner. Additionally, the staff evaluation indicated that the 70 cm bore scanner was more favorable for the patients than the 60 cm scanner.

It has been illustrated that MRI in an open scanner may be the only way for patients with anxiety problems to endure an examination. If open scanners are unavailable, different interventions are needed to enable these patients to undergo an examination. Patient anxiety in connection with MRI is a challenge for the radiographers necessitating constant improvements in coaching as well as in investigative technology.

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