Improving children’s cooperativeness during magnetic resonance imaging using interactive educational animated videos: a prospective, randomised, non-inferiority trial

Evelyn Gabriela Utama, MD, BSc (Hons), Seyed Ehsan Saffari, PhD, Phua Hwee Tang, MBBS, FRCP
1Duke-NUS Medical School, 2Centre for Quantitative Medicine, Duke-NUS Medical School, 3Department of Diagnostic and Interventional Imaging, KK Women’s and Children’s Hospital, Singapore

Abstract

Introduction: A previous prospective, randomised controlled trial showed that animated videos shown to children before magnetic resonance imaging (MRI) scan reduced the proportion of children needing repeated MRI sequences and improved confidence of the children staying still for at least 30 min. Children preferred the interactive video. We hypothesised that the interactive video is non-inferior to showing two videos (regular and interactive) in improving children’s cooperativeness during MRI scans.

Methods: In this Institutional Review Board-approved prospective, randomised, non-inferiority trial, 558 children aged 3–20 years scheduled for elective MRI scan from June 2017 to March 2019 were randomised into the interactive video only group and combined (regular and interactive) videos group. Children were shown the videos before their scan. Repeated MRI sequences, general anaesthesia (GA) requirement and improvement in confidence of staying still for at least 30 min were assessed.

Results: In the interactive video group (n = 277), 86 (31.0%) children needed repeated MRI sequences, two (0.7%) needed GA and the proportion of children who had confidence in staying still for more than 30 min increased by 22.1% after the video. In the combined videos group (n = 281), 102 (36.3%) children needed repeated MRI sequences, six (2.1%) needed GA and the proportion of children who had confidence in staying still for more than 30 min increased by 23.2% after the videos; the results were not significantly different between the two groups.

Conclusion: The interactive video group demonstrated non-inferiority to the combined videos group.

Keywords: Interactive video, magnetic resonance imaging, paediatrics, quality improvement, radiology

INTRODUCTION

Magnetic resonance imaging (MRI) is the imaging modality of choice in paediatrics, as it provides high-quality images that are free of ionising radiation. The procedure requires the patient to remain still during the scan, which can take up to 1 h. This could prove difficult for children, as the unfamiliar environment and staff, loud noises, confined space and the need to lie still could contribute much to their anxiety and distress, causing them to become uncooperative during the scan. The resulting motion artefacts could lead to non-diagnostic scans, thus necessitating repeated examinations. Repeated scans may be done under general anaesthesia (GA) or sedation, which has risks and complications of hypoxia, apnoea, vomiting, prolonged sedation and the need for assisted ventilation. Avoiding GA and repeated or rescheduled scans can significantly reduce the length of the hospital visit, decrease overall procedure-related expenses and improve the efficiency of patient flow.

Several non-pharmacological strategies have been used in a paediatric medical environment to improve children’s cooperativeness during their scans. These include parental

Correspondence: Dr. Phua Hwee Tang, Senior Consultant, Department of Diagnostic and Interventional Imaging, KK Women’s and Children’s Hospital, 100 Bukit Timah Road, 229899, Singapore. E-mail: tang.phua.hwee@singhealth.com.sg

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involvement, preprocedural preparation and use of distractions. Parents help to comfort and reduce anxiety of their children by being physically present with them. They can also help to position and immobilise their child to improve image quality. Adequate preprocedural preparation, such as the use of a life-sized MRI simulator, a miniature MRI model, play therapy, a child life specialist, educational modelling films and animated videos, can improve children’s confidence in coping with the procedure and increase the level of satisfaction and confidence in parents.\textsuperscript{[5–9]} During the scan, distraction tools, such as videos, movies, toys, pacifiers and other comfort items brought in by the child’s parents, can be used. Some computed tomography and MRI departments have installed colour lighting systems that not only serve as distractions by projecting light on the walls, but also give instructions during breath-holding sequences and provide positive reinforcement for cooperation.\textsuperscript{[5,7]} However, due to space constraints, limited clinical manpower and expenditure budgets, strategies such as mock MRI scanners, play therapy and colour lighting systems in the MRI rooms may not be feasible.

Animated videos have been shown to be a very promising preimaging preparation tool, as it is easily accessible and can be distributed online. Patients can view the videos anywhere and reinforce their knowledge of the procedure by watching the video multiple times. Animated videos have been shown to educate children about MRI scans and help reduce anxiety in children aged 5–11 years.\textsuperscript{[10]} A randomised controlled trial comparing the effect of full (simulator practice, movie and instructional booklet) and partial (instructional booklet only) instruction in children aged 5–16 years showed that the group that received full instruction had 20% lower GA rates compared to the partial instruction group.\textsuperscript{[11]} As these studies were either small randomised studies or did not study the effect of videos alone, Ong \textit{et al.}\textsuperscript{[2]} conducted a larger randomised controlled trial that examined the influence of educational animated videos on children’s cooperativeness during MRI scans. In the three-arm study (control, regular animated video only, and combined regular and interactive animated videos groups), it was found that both the intervention groups significantly decreased the number of children needing repeated MRI sequences and increased the proportion of children who had confidence in staying still for more than 30 min. Without intervention, 47.7% required repeated sequences, while there was a 13% ($P = 0.005$) and 19.6% ($P < 0.001$) reduction in the proportion of children who needed a repeated MRI sequence in the regular video group and the combined videos group, respectively. The proportion of children who had confidence in staying still for more than 30 min increased by 21% ($P < 0.001$) and 32.1% ($P < 0.001$) in the regular video group and combined videos group, respectively. There was no significant decrease in the proportion of children needing GA across the three groups.\textsuperscript{[3]} In the combined videos group, the authors also found that the children generally preferred the interactive video to the regular video (unpublished data).

Compared to the regular video group, the combined videos group generally had a greater reduction in the proportion of children needing repeated MRI sequences and a greater increase in the children’s confidence of staying still for more than 30 min. However, it is unknown which video contributed more to the outcome in the combined videos group.\textsuperscript{[2]} Since the study looked only at the effect of regular video alone, and more children preferred the interactive video to the regular video, we aimed to investigate the effect of the interactive video alone. We studied whether the interactive video is as efficacious as showing two videos (regular and interactive) in reducing the proportion of children needing repeated MRI sequences and GA, and increasing the proportion of children who had confidence in staying still for more than 30 min. In addition, we investigated whether the effect of videos differs among the various body parts being scanned.

**METHODS**

Over the period of June 2017–March 2019, paediatric patients aged 3–20 years scheduled for an elective MRI scan at the KK Women’s and Children’s Hospital (KKH) were recruited and assessed for eligibility based on the inclusion and exclusion criteria. The inclusion criteria were patients aged 3–20 years who were scheduled for MRI scan and had never received video intervention before. The exclusion criteria were patients who were scheduled for GA, those who were intubated, those warded in the intensive care unit, and those with autism spectrum disorder, Down’s syndrome and/or an altered mental state.

The prospective, randomised, non-inferiority trial was approved by the SingHealth Institutional Review Board (reference: 2015/3094). Patients were randomised into two groups: interactive animated video only group and combined (regular and interactive) videos group. The group to which each patient was assigned was generated by a computer randomisation sequence and concealed within sequentially numbered, opaque, sealed envelopes. The patients were shown the videos at the waiting area before their MRI scan. The videos used in this study were the same as the ones used in the study by Ong \textit{et al.}\textsuperscript{[2]} The regular animated video lasts 2 min and follows the story of Tim, a boy undergoing an MRI examination under the guidance of Dr Potato. The interactive animated video lasts 2–3 min and allows the patient to help a panda go through an MRI scan using touch buttons on the screen. Pre-recorded MRI sounds were incorporated into the interactive animated video. These videos were assessed and vetted by two child psychologists who deemed them suitable for the proposed age group.

Patients were asked to assess their confidence of staying still for at least 30 min before and after watching the videos. This threshold was chosen, as it is the average duration of an MRI scan and is also the average duration of a kids’ cartoon on television. Children needing repeated MRI sequences or GA
were noted. The decision to conduct repeated MRI sequences or anaesthetise the child was made by the radiologist and radiographer on duty based on the child’s behaviour and diagnostic quality of the scans. Only moderate and marked motion artefacts that render a scan non-diagnostic warranted a repeat scan. The decision to anaesthetise the patient was based on the following criteria: (a) if no diagnostic images were achieved after three attempts at the initial sequence or (b) if the child refused to cooperate and lie down on the MRI scan table. Only the professional who showed the videos and surveyed the patients was not masked to the group allocation.

Based on our previous experience,[2] having 257–267 patients in each group was sufficient to demonstrate the differences in subjective (confidence in staying still for MRI) and objective (requirement for GA, requirement for repeated MRI sequences) outcomes. In this two-arm, randomised trial, a sample size of 273 in each group was needed to achieve 80% power to detect a non-inferiority margin difference between the group proportions of 11%. The proportion of repeated scans in the interactive video group and the combined videos group was assumed to be 41% and 30%, respectively, under the null hypothesis of inferiority. Power calculation was performed using non-inferiority test of difference in the two sample proportions, Z-test (unpooled) via normal approximation to the binomial distribution. The significance level of the test was 0.025.

Statistical analysis was performed using the IBM SPSS Statistics version 23.0 for Windows (IBM Corp., Armonk, NY, USA). Data was summarised using mean and standard deviation for continuous variables and frequency and percentage for categorical variables. Chi-square test was used to compare the proportion of children needing repeated MRI sequences and GA between the two groups. Independent two-sample t-test was used to compare differences in age and scan duration between the two groups. McNemar’s test for paired samples was used to compare the proportion of children confident of staying still for more than 30 min before and after the videos within each group. Univariate and multivariable regression analyses were performed to assess the factors associated with the need for repeated MRI sequences. All P values were two-sided, and results were deemed statistically significant at P < 0.05.

RESULTS

A total of 686 children were assessed for eligibility and 128 were excluded based on the exclusion criteria. The remaining 558 children were randomised into interactive animated video group (n = 277) and combined animated videos group (n = 281). The patient recruitment flowchart is illustrated in Figure 1.

Demographic variables including age, gender and race were comparable between the two intervention groups. The groups were also similar in terms of scan-related details, including prior MRI experience, requirement for intravenous contrast and scan duration. In the interactive video group (n = 277), 86 (31.0%) children needed repeated MRI sequences, two (0.7%) needed GA and the proportion of children who had confidence in staying still for more than 30 min increased by 22.1% after watching the video. In the combined videos group (n = 281), 102 (36.3%) children needed repeated MRI sequences, six (2.1%) needed GA and the proportion of children who had confidence in staying still for more than 30 min increased by 23.2% after watching the videos [Table 1].

Children who required repeated MRI sequences (n = 188) showed significant differences in age (P < 0.0001) and gender (P < 0.001) compared to those who did (n = 370) [Table 2]. Logistic regression analysis showed that older children were less likely to have repeated MRI sequences (odds ratio [OR] 0.859, 95% confidence interval [CI] 0.808, 0.913, P < 0.0001), whereas male children were more likely to have repeated or rescheduled scans (OR 1.718, 95% CI 1.175, 2.510, P = 0.005) [Table 3]. Subgroup analysis on children needing rescheduling under GA was not performed due to the small sample size (n = 8) [Table 1].

In children aged 3–7 years, there were no differences in repeated MRI sequences and GA between the two intervention groups. There was no significant increase in the proportion of children who had confidence in staying still for more than 30 min in the interactive video group (P = 0.625), whereas it was significantly increased by 17.7% in the combined videos group (P = 0.031). Among children aged 8–12 years (n = 224),
there were no significant differences in the proportion of children having repeated MRI sequences ($P = 0.189$) and GA between the two groups. There were significant increases in the proportion of children who had the confidence in staying still for more than 30 min in both groups ($P < 0.0001$). Among children aged 13–20 years ($n = 271$), there were no significant
differences in the proportion of children having repeated MRI sequences ($P = 0.549$) and GA ($P = 0.322$) between the two intervention groups. There were significant increases in the proportion of children who had confidence in staying still for more than 30 min in both groups ($P < 0.0001$) [Table 4].

Subgroup analysis was done to assess the effect of videos on different body regions being scanned. As most of the children had a single MRI scan ($n = 504$), those who had multiple scans ($n = 54$) requiring longer scan duration were excluded from subgroup analysis. Regions such as head and neck ($n = 6),

Table 1. Demographic variables and clinical features of children in the interactive and combined video groups.

| Variable               | Interactive ($n=277$) | Combined ($n=281$) |
|------------------------|-----------------------|--------------------|
| Age (yr)               | 12.0±3.26             | 11.8±3.28          |
| Gender                 |                       |                    |
| Male                   | 138 (49.8)            | 136 (48.4)         |
| Female                 | 139 (50.2)            | 145 (51.6)         |
| Race                   |                       |                    |
| Chinese                | 184 (66.4)            | 193 (68.7)         |
| Malay                  | 50 (18.1)             | 45 (16.0)          |
| Indian                 | 33 (11.9)             | 29 (10.3)          |
| Others                 | 10 (3.6)              | 14 (5.0)           |
| Prior MRI experience   | 59 (21.3)             | 60 (21.4)          |
| Required contrast      | 81 (29.2)             | 82 (29.2)          |
| Scan duration (min)    | 27:41±9:54            | 28:15±9:46         |

Outcomes

| Required repeated MRI sequences | Interactive 86 (31.0) | Combined 102 (36.3) |
| Required GA | 2 (0.7) | 6 (2.1) |

Confident of staying still for ≥30 min

| Before video | 63 (22.7) | 56 (19.9) |
| After video  | 124 (44.8) | 121 (43.1) |

a Chi-square test for categorical variables, independent two-sample t-test for continuous variables.

Table 2. Comparison of children who required repeated MRI sequences and those who did not.

| Variable               | Repeated MRI ($n=188$) | No repeated MRI ($n=370$) | P* |
|------------------------|------------------------|---------------------------|----|
| Allocated group        |                        |                           |    |
| Interactive video      | 86 (45.7)              | 191 (51.6)                | 0.189 |
| Combined videos        | 102 (54.3)             | 179 (48.4)                |    |
| Age (yr)               | 10.8±3.34              | 12.5±3.08                 | <0.0001 |
| Gender                 |                        |                           |    |
| Male                   | 112 (59.6)             | 162 (43.8)                | <0.001 |
| Female                 | 76 (40.4)              | 208 (56.2)                |    |
| Race                   |                        |                           |    |
| Chinese                | 137 (72.9)             | 240 (64.9)                |    |
| Malay                  | 25 (13.3)              | 70 (18.9)                 |    |
| Indian                 | 19 (10.1)              | 43 (11.6)                 |    |
| Others                 | 7 (3.7)                | 17 (4.6)                  |    |
| Prior MRI experience   | 41 (21.8)              | 78 (21.1)                 | 0.843 |
| Required contrast      | 58 (30.9)              | 105 (28.4)                | 0.544 |
| Scan duration (min)    | 28:04±11:30            | 27:55±8:57                | 0.879 |

a Chi-square test for categorical variables, independent t-test for continuous variables.

Table 3. Summary of univariate and multivariable logistic regression analyses for repeated MRI sequence.

| Variable               | Univariate | Multivariable* |
|------------------------|------------|---------------|
|                        | OR (95% CI) | P      | OR (95% CI) | P      |
| Group                  |            |        |            |        |
| Interactive vs. combined videos | 0.79 (0.556, 1.124) | 0.190 | 0.828 (0.57, 1.204) | 0.324 |
| Age                    | 0.849 (0.802, 0.896) | <0.0001 | 0.859 (0.808, 0.913) | <0.0001 |
| Gender                 |            |        |            |        |
| Male vs. female        | 1.892 (1.325, 2.702) | <0.001 | 1.718 (1.175, 2.510) | 0.006 |
| Race                   |            |        |            |        |
| Malay vs. Chinese      | 0.626 (0.379, 1.034) | 0.067 | 0.732 (0.431, 1.246) | 0.251 |
| Indian vs. Chinese     | 0.774 (0.434, 1.382) | 0.386 | 0.824 (0.448, 1.516) | 0.534 |
| Others vs. Chinese     | 0.721 (0.292, 1.783) | 0.479 | 0.632 (0.246, 1.628) | 0.342 |
| Prior MRI experience   | 1.044 (0.681, 1.600) | 0.843 | 1.361 (0.831, 2.331) | 0.221 |
| Required contrast      | 1.126 (0.768, 1.652) | 0.544 | 0.78 (0.479, 1.271) | 0.319 |
| Scan duration          | 1.00003 (0.9997, 1.0004) | 0.868 | 1.0002 (0.9998, 1.001) | 0.378 |

*Adjusted for allocated intervention group, age, gender, race, prior MRI experience, required intravenous contrast and scan duration. CI: confidence interval, MRI: magnetic resonance imaging, OR: odds ratio
Table 4. Demographic variables and clinical features of interactive and combined video groups by age groups.

| Variable                      | Age 3–7 years* | Age 8–12 years† | Age 13–20 years‡ |
|-------------------------------|----------------|-----------------|------------------|
| Age (yr)                      | Interactive (n=29) | Combined (n=34) | P*               |
|                               | 6.07±1.03       | 6.21±0.98       | 0.591            |
| Gender                        | Male            | 16 (55.2)       | 17 (50.0)        | 0.682 |
|                               | Female          | 13 (44.8)       | 17 (50.0)        | 0.496 |
| Race                          | Chinese         | 21 (72.4)       | 27 (79.4)        | 0.449 |
|                               | Malay           | 3 (10.3)        | 4 (11.8)         | 0.740 |
|                               | Indian          | 4 (13.8)        | 1 (2.9)          | 0.762 |
|                               | Others          | 1 (3.4)         | 2 (5.9)          | 0.740 |
| Prior MRI experience          | 3 (10.3)        | 3 (8.8)         | 0.838            |
| Required contrast             | 14 (48.3)       | 11 (32.4)       | 0.198            |
| Scan duration (min)           | 28:41±7:55      | 25:36±11:21     | 0.305            |
| Outcomes                      | Repeated MRI sequences | 18 (62.1)      | 21 (61.8)        | 0.98  |
|                               | Required GA     | 2 (6.9)         | 5 (14.7)         | 0.326 |
| Confident of staying still for ≥30 min | 0.625 (Interactive), 0.031 (Combined)* | <0.0001* | <0.0001* |
| Before video                  | 4 (13.8)        | 3 (8.8)         | 21 (18.4)        | 28 (28.4) |
| After video                   | 6 (20.7)        | 9 (26.5)        | 45 (39.5)        | 73 (54.5) |

*Data presented as mean±standard deviation or n (%). *Chi-square test for categorical variables, independent t-test for continuous variables. †McNemar’s test for paired variable within each intervention group (comparing confidence before vs. after the intervention). GA: general anaesthesia, MRI: magnetic resonance imaging.

Discussion

In this study, demographic parameters (age, gender and race) and outcome proportions were consistent with those reported in the study by Ong et al., demonstrating an adequate randomisation process and lack of selection bias.[2] In our study, fewer children had prior MRI experience and needed contrast as compared to the study by Ong et al.[3] The results of this randomised, non-inferiority trial revealed that the interactive animated video was overall as efficacious as showing two videos, with both groups demonstrating comparable repeated MRI sequences and GA proportions, and overall increase in confidence level in staying still for at least 30 min.

Since this study recruited patients aged 3–20 years, we were able to identify the type of children who are more likely to need repeated imaging or GA. Children between 3 and 7 years of age are more likely to be uncooperative and therefore need repeated MRI sequences or GA. This was observed in the study by Ong et al.,[3] and this age range is the focus of most clinical studies that aimed to improve children’s cooperation.[5,9,12,13] It is understandable that this age range had the highest proportion of children needing repeated imaging or GA, as they are still developmentally immature in their level of understanding. Some studies had to exclude children below the age of 7 or 8 years, as they utilised self-reported tools such as anxiety and stress symptom scales, which may be difficult to comprehend for younger children.[14,15] Therefore, more research should be

abdomen (n = 17) and pelvis (n = 4) were too small for subgroup analysis. Patients who had special studies (n = 38) such as cardiac flow analysis, chest, brachial plexus and carotid vessels were also excluded from the analysis. Brain scans refer to scans of the internal acoustic meatus, orbits, pituitary fossa and whole brain scan. Musculoskeletal scans refer to scans of the upper and lower extremities and the axial skeleton.

Since the majority of children required scans of the brain (n = 202) and the musculoskeletal system (n = 237), subgroup analysis was done for these two subgroups. Among children who had brain scans, there were no significant differences in the proportion of children having repeated MRI sequences (P = 0.571) and GA (P = 0.448) between the two groups. There were significant increases in the proportion of children who had confidence in staying still for more than 30 min in both groups (P < 0.001). Among children who had scans of the musculoskeletal system, there were no significant differences in the proportion of children having repeated MRI sequences (P = 0.160) and GA (P = 0.179) between the two groups. There were significant increases in the proportion of children who had confidence in staying still for more than 30 min in both groups (P < 0.0001). It was noted that brain scans had shorter scan durations compared to musculoskeletal scans. Brain scans also had higher proportions of children needing repeated MRI sequences as compared to musculoskeletal scans [Table 5].
Table 5. Demographic variables and clinical features of interactive and combined video groups by scanned region.

| Variable                      | Interactive (n=111) | Combined (n=91) | P*   | Interactive (n=112) | Combined (n=125) | P*  |
|-------------------------------|--------------------|----------------|------|---------------------|------------------|-----|
| Age (yr)                      | 11.0±3.28          | 10.4±3.30      | 0.179| 12.8±2.75           | 12.8±2.89        | 0.892|
| Gender                        |                    |                | 0.453|                     |                  |     |
| Male                          | 68 (61.3)          | 51 (56.0)      |     | 44 (39.3)           | 55 (44.0)        | 0.463|
| Female                        | 43 (38.7)          | 40 (44.0)      |     | 68 (60.7)           | 70 (56.0)        |     |
| Race                          |                    |                | 0.483|                     |                  | 0.530|
| Chinese                       | 81 (73.0)          | 67 (73.6)      |     | 67 (59.8)           | 86 (68.8)        |     |
| Malay                         | 15 (13.5)          | 11 (12.1)      |     | 28 (25.0)           | 23 (18.4)        |     |
| Indian                        | 13 (11.7)          | 8 (8.8)        |     | 9 (8.0)             | 9 (7.2)          |     |
| Others                        | 2 (1.8)            | 5 (5.5)        |     | 8 (7.1)             | 7 (5.6)          |     |
| Prior MRI experience          | 21 (18.9)          | 11 (12.1)      | 0.186| 15 (13.4)           | 21 (16.8)        | 0.466|
| Required contrast             | 34 (30.6)          | 19 (20.9)      | 0.117| 19 (17.0)           | 26 (20.8)        | 0.452|
| Scan duration (min)           | 23.52±6.51         | 22.30±6.16     | 0.153| 28.19±9.24          | 28.20±6.38       | 0.99 |
| Outcomes                      |                    |                |      |                     |                  |     |
| Repeated MRI sequences        | 42 (37.8)          | 38 (41.8)      | 0.571| 25 (22.3)           | 38 (30.4)        | 0.16 |
| Required GA                   | 1 (0.9)            | 2 (2.2)        | 0.448| 0 (0)               | 2 (1.6)          | 0.179|
| Confident of staying still for |                    |                |      |                     |                  |     |
| ≥30 min                       |                    |                |      |                     |                  |     |
| Before video                  | 18 (16.2)          | 16 (17.6)      |      | 26 (23.2)           | 25 (20.0)        |     |
| After video                   | 35 (31.5)          | 37 (40.7)      |      | 58 (51.8)           | 56 (44.8)        |     |

*Data presented as mean±standard deviation or n (%). †Chi-square test for categorical variables, independent t-test for continuous variables. McNemar’s test for paired variable within each intervention group (confidence before vs. after the intervention). GA: general anaesthesia, MRI: magnetic resonance imaging.

done to evaluate the best preprocedural intervention for children between 3 and 7 years of age. Interestingly, the proportion of children aged 3–7 years who did the scan under GA is lower in the current study as compared to the study by Ong et al.[15] This could be due to increased awareness of staff on which children would be able to tolerate an MRI scan without GA. In addition, a few parents in this study had requested the anaesthesiologist to let their children try the scan without GA, thus lowering the incidence of GA in the current population. Although we have not explored the parents’ intentions for attempting the scan without GA for their children, these parents could be more aware of and educated about the risks associated with GA.

Different body regions have different scan durations and some are prone to motion artefacts. On categorising children into different subgroups based on the region of the body being scanned, it was found that the majority of children were scheduled for scans of the brain and the musculoskeletal system. The common indications for brain scans include headaches, seizures and follow-up of brain malignancies, while the common indications for musculoskeletal scans include injury, lumps and pain. In both subgroups, the interactive video group demonstrated non-inferiority to the combined videos group by showing comparable repeated MRI sequences and GA proportions and similar increase in the proportion of children who were confident of staying still for at least 30 min. It was noted that despite the musculoskeletal scans having longer scan durations, there was a smaller proportion of children who needed repeated MRI sequences compared to children who had brain scans. Children who had brain scans were younger than those undergoing musculoskeletal scans and could be anxious or frightened, as their heads had to be confined inside a head coil, in addition to having to lie down inside the machine. The noise from the MRI machine could also be particularly loud for these children, as the sequences used for brain imaging differ from those used for musculoskeletal imaging. This is in contrast to musculoskeletal scans, in which the positioning of the patient is dependent on the region of interest and only the region of interest needs to be enclosed within the coil.

Preprocedural preparation, such as the use of interactive animated educational videos, is important as it tells the patient what would happen and gives them an opportunity to experience what they would potentially feel during the procedure. This gives children the opportunity to rehearse the process of going through a medical procedure and helps them learn to cope with it. Anything a child may experience during the procedure can be rehearsed; however, several pertinent points should be covered. These include (a) duration of test, (b) location of test, (c) sequence of events, (d) sources of discomfort, (e) sensations that may be experienced, and (f) how the child may feel when the procedure is done.[17] When exposed to such information, the child would be able to mentally practise the impending stressful event, develop accurate expectations and thereby manage better than those who have not thought about what is going to happen to them.
The use of preimaging interactive educational animated videos is a cost-effective, non-pharmacological intervention as the video can be viewed repeatedly at anytime and anywhere. This is in contrast to the use of a life-sized MRI simulator, which requires space and manpower and is expensive.\textsuperscript{[18]} It is, however, important to note that no single intervention alone is enough to help improve children’s cooperativeness. Parental involvement, preprocedural interventions and the use of distractions during the scan can all help to increase children’s ability to cope with the procedure and increase the level of satisfaction and confidence in children and their parents.

This study was not without limitations. As the videos were in English, they would need to be reformatted for people who have no English literacy or who have hearing or visual impairment. Young children may not be able to understand the concept of time and hence have difficulty answering questions regarding staying still for 30 min. The current sample size for children aged 3–7 years is small. The children were not blinded to their intervention group assignments, and the outcomes observed could be due to the placebo effects in those exposed to the videos.

Further studies can be done to evaluate the effect of increased video exposure, such as viewing the video several times before the scan, as information reinforcement could contribute to a larger effect than what was observed with the current one-time viewing. In addition, the studies can investigate the ability and willingness of parents to help their children mentally rehearse the event and practise staying still for increasing lengths of time, and how these would have an effect on the outcomes.

As the interactive video is currently formatted for the android tablet, we are interested to format it to be playable on the hospital’s website, so that it can be accessed on any type of electronic device such as the computer or handphone. We are also looking into creating videos for other imaging modalities such as ultrasound, fluoroscopy and nuclear medicine.

In conclusion, the interactive video is as efficacious as showing two videos in reducing of the proportion of children needing repeated MRI sequences and increasing the proportion of children who had confidence in staying still for more than 30 min during an MRI scan.

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Conflicts of interest

There are no conflicts of interest.

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