ORIGINAL ARTICLE
Turk J Surg 2026;42(1):73-84

Examination of the effects of virtual reality glasses and stress ball applications on pain, vital signs, anxiety, fear, satisfaction, and comfort levels during the dressing changes in patients who underwent abdominal surgery

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ABSTRACT

Objective: To examine the effects of virtual reality glasses and stress-ball use on pain, vital signs, anxiety, fear, satisfaction, and comfort during dressing changes in patients undergoing abdominal surgery.

Material and Methods: This research is a randomized experimental study with pretest-posttest control group design. The study was conducted from 8 August to 20 November 2024 in general surgery unit 1 of a city hospital in the Mediterranean Region of Türkiye. A total of 156 patients who underwent abdominal surgery and met the sampling criteria were included in the study: 52 in the virtual reality group, 52 in the stress ball group, and 52 in the control group. Data were collected using the socio-demographic and clinical characteristics form, state-trait anxiety inventory, and visual analog scale.

Results: Patients who were given virtual reality glasses and a stress ball during dressing changes reported higher levels of comfort and relaxation than those in the control group. Fear levels during dressing changes were also higher in the virtual reality group than in the other groups. Anxiety levels were lower in the intervention groups (virtual reality and stress ball) compared to the control group. No statistically significant differences were found among the groups with respect to pain, vital signs, or satisfaction.

Conclusion: The use of virtual reality glasses and stress balls during dressing changes in patients appears to be effective in enhancing comfort and reducing anxiety.

Keywords: Abdominal surgery, dressing, virtual reality glasses, stress ball, anxiety, pain, comfort, satisfaction

INTRODUCTION

Surgical wound management is an inseparable part of surgery, requiring the use of effective dressing techniques to accelerate wound healing and reduce the risk of infection (1). According to the literature, healthcare workers need to reduce patients' worries during dressing changes and take precautions to alleviate pain (2,3). Oral or topical analgesics remain the primary treatment for pain after surgery. However, pharmacologic treatment alone is not sufficient to eliminate pain (4). With advances in computer technology, virtual reality (VR) glasses have emerged as an immersive and compelling psychologically based approach that can divert patients' attention from painful stimuli and thereby alleviate pain during invasive procedures (2,4). The literature indicates that the use of a stress ball (SB) during minor surgical procedures provides patients with a sense of empowerment by conferring perceived control over the SB. Additionally, it has been shown to reduce pain and anxiety while increasing patient satisfaction (5).

Several studies have examined the effects of VR glasses during procedures such as hemorrhoid treatment, hand-injury management, and burn dressing changes (2,4,6,7). A study examining the effect of using VR glasses on pain levels during dressing changes after hemorrhoid surgery found no significant differences in heart rate or oxygen saturation between the control (n=91) and intervention (n=91) groups on pre- and post-tests. However, the use of VR in combination with analgesia was found to be effective during dressing changes (4). In a study evaluating the effect of VR glasses on pain in patients with hand injuries undergoing dressing changes, the use of VR glasses

Cite this article as: Yanık Z, Baksi A. Examination of the effects of virtual reality glasses and stress ball applications on pain, vital signs, anxiety, fear, satisfaction, and comfort levels during the dressing changes in patients who underwent abdominal surgery. *Turk J Surg.* 2026;42(1):73-84

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Received: 24.10.2025
Accepted: 12.02.2026
Publication Date: 05.03.2026

DOI: 10.47717/turkjsurg.2026.2025-10-24

Available at **www.turkjsurg.com**

resulted in a statistically significant reduction in pain (2). A review of the literature found no studies investigating the effects of the use of VR glasses and SB on pain, vital signs, anxiety, fear, satisfaction, and comfort levels in adult patients undergoing abdominal dressing procedures. The study aims to examine the effects of the use of VR glasses and SB on pain, vital signs, and levels of anxiety, fear, satisfaction, and comfort in patients undergoing abdominal surgery during postoperative dressing changes.

The Hypotheses of the Study

$H_1$1. During dressing changes in patients undergoing abdominal surgery, the pain levels in the VR glasses and the SB groups are significantly lower than those in the control group.

$H_1$2. During dressing changes in patients undergoing abdominal surgery, vital signs in the VR glasses and SB groups were significantly closer to normal than those in the control group.

$H_1$3. During dressing changes in patients undergoing abdominal surgery, anxiety levels in the VR-glasses and SB groups are significantly lower than those in the control group.

$H_1$4. During dressing changes in patients undergoing abdominal surgery, fear levels in the VR-glasses and SB groups are significantly lower than those in the control group.

$H_1$5. During dressing changes in patients undergoing abdominal surgery, satisfaction levels in the VR-glasses and SB groups are significantly higher than those in the control group.

$H_1$6. During dressing changes in patients undergoing abdominal surgery, comfort levels in the VR-glasses and SB groups are significantly higher than those in the control group.

MATERIAL and METHODS

Design

This study employed a randomized, controlled, pretest-posttest experimental design.

Population and Sample of the Study

The study was conducted in the general surgery clinic 1 at a city hospital in the Mediterranean Region of Türkiye. Patients in the study were randomly assigned to three groups: The VR glasses group (n=52), the SB group (n=52), and the control group (n=52). The study sample consisted of 156 participants (Figure 1). In the study, post-hoc 1-β power analysis ranged from 0.82 to 1.00 for state anxiety, fear, satisfaction, and comfort.

Inclusion criteria for the study sample:

- Providing both written and verbal consent to participate in the study,
- Being 18 years of age or above,
- Having undergone abdominal surgery,
- Being on the first postoperative day,

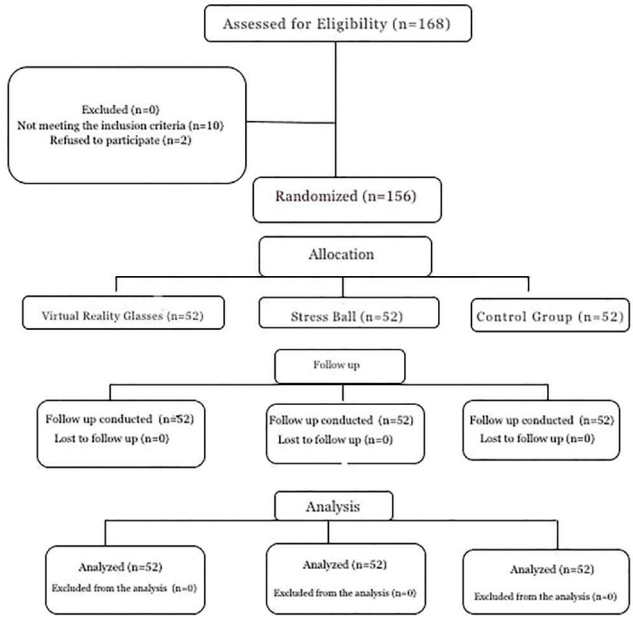

Figure 1. CONSORT flow diagram.

- Being subject to the first dressing change after surgery,
- Staying in a single room or being the only patient in the room,
- Having an alert consciousness with orientation to person, place, and time,
- Patients with no visual, hearing and communication impairments will be included in the study.

Exclusion criteria for the study sample:

- Patients who received analgesic, anxiolytic, or sedative medications before, during, or immediately after the dressing change,
- Having chronic pain condition/syndrome,
- Having a disease that primarily affects vital signs, such as hypertension or COPD,
- Having any psychiatric or cognitive/mental disorder (e.g., dementia),
- Having chronic diseases such as epilepsy and vertigo,
- Having alcohol or drug addiction or misuse,
- Removal of the VR glasses during the dressing procedure,
- Ineffective use of the stress ball during the dressing procedure (e.g., merely holding it without squeezing).

Randomization Method

Before data collection, stratified randomization was used to ensure a homogeneous sample distribution. Participants were stratified into four subgroups based on two key variables: Gender (female/male) and age (<65 years/65 years): (1) females <65

years, (2) females 65 years, (3) males <65 years, and (4) males 65 years. Within each stratum, participants were randomly assigned to the VR, ST, and control groups using a lottery method to determine group order. Subsequently, sequential numbers (1, 2, 3, …, 30) were assigned to the groups, and participants were enrolled in the corresponding group according to the order of patient admission. Before the commencement of the study, the protocol was registered on ClinicalTrials.gov (Identifier: NCT06476314).

Data Collection Tools

Socio-demographic and clinical characteristics form

The form, developed by researchers, consists of questions regarding the patient's age, gender, surgical history, use of analgesics, and whether they were informed about the dressing change (8,9). This form also records the patient's vital signs.

Visual analog scale for pain, fear, satisfaction, and comfort

The scale, developed by Price (1983), measures the distance between two endpoints using a 10-centimeter ruler, with 0 representing the minimum possible value and 10 representing the maximum possible value. In this context, the patient is informed that there are two endpoints on the scale and may mark a point between them that best represents the intensity of the pain they are experiencing. In this study, the scale was used to determine pain, fear, satisfaction and comfort levels experienced by patients who underwent abdominal surgery during dressing change (9,10).

The state-trait anxiety inventory

The inventory was developed by Spielberger and his colleagues and was adapted into Turkish by Öner and Le Compte (1985). The inventory consists of two subscales, comprising a total of 40 items. The state anxiety scale, comprising the first 20 items of the inventory, assesses predisposition to anxiety related to individual characteristics. The trait anxiety scale, comprising items 21 to 40 of the inventory, is designed to assess a patient's anxiety in response to stressful situations. Scores obtained from both scales range from 20 to 80. Spielberger and his colleagues suggest that scores between 0 and 19 on both scales indicate no anxiety, scores between 20 and 39 indicate mild anxiety, scores between 40 and 59 indicate moderate anxiety, and scores between 60 and 79 indicate severe anxiety. Furthermore, individuals scoring 60 or above require professional support (11). In this study, the inventory was used to determine the state-trait anxiety levels of patients who underwent abdominal surgery. Cronbach's alpha values in the VR group were 0.89 (state-pre), 0.85 (state-post), and 0.87 (trait); in the stress-ball group were 0.94 (stat-pre), 0.85 (state-post), and 0.93 (trait); and in the control group were 0.94 (state-pre), 0.92 (state-post), and 0.86 (trait).

Data Collection

The research data were collected between August 8, 2024, and November 20, 2024, by one of the researchers, a surgical clinical nurse working in the general surgery-1 unit. Dressing changes for patients who underwent abdominal surgery were performed by the general surgery clinic physician and the nurse researcher. The patient was usually placed in a supine position with the head elevated 15-20 degrees during the dressing procedure.

Personal protective measures for infection control were followed throughout the study. The patient was asked to wear a disposable hygienic pad/mask (LINHUIPAD Disposable VR Facial Cover Mask) that had sweat-absorbing properties and was compatible with the device, and the VR glasses were then placed over the mask. At the end of the procedure, a disposable disinfectant wipe (BIORAD Derm Disposable Disinfectant Wipe) was used to decontaminate the VR glasses and the SB, which were then left to air-dry on a clean decontamination surface. In the study, the Meta Quest 2 VR glasses were used. Participants were shown a preloaded video featuring natural landscapes. Due to the glasses' display resolution of 1832×1920 pixels, the visual content was perceived as highly clear and detailed. The stereo-speaker feature enabled clear, high-quality sound transmission. The VR glasses, weighing 503 grams, facilitated portability during use and did not cause any discomfort for the participants. The SB used as an exercise tool is egg-shaped, moderately firm, has a diameter of 6 cm, and is made of silicone. Owing to these features, the participants could easily grasp and use it. In the study, all patients' vital signs were measured on the right arm.

In the VR glasses group, patients' demographic characteristics, pain levels, vital signs, state and trait anxiety, fear, satisfaction, and comfort levels were assessed 5-10 minutes before the dressing change. During the dressing change , which lasted approximately 5 minutes, the patient viewed 360-degree nature videos via VR glasses and simultaneously listened to nature sounds. Five to ten minutes after the completion of the dressing procedure, patients' pain levels, vital signs, state anxiety, fear, satisfaction, and comfort levels were re-evaluated, and post-test data were collected. In the SB group, patients' demographic characteristics, pain levels, vital signs, state and trait anxiety, fear, satisfaction, and comfort levels were assessed 5 to 10 minutes before the dressing change. During the dressing procedure, the patient was given a SB and instructed to squeeze the ball once each time they counted to five. Five to ten minutes after the completion of the dressing procedure, patients' pain, vital signs, state anxiety, fear, satisfaction, and comfort were assessed, completing the post-test data collection. Patients in the control group received no intervention other than routine care, and data were collected at the same time as those in the intervention groups.

Statistical Analysis

Data were analyzed using the Statistical Package for Social Sciences (SPSS) version 25.0 (IBM Corp., Armonk, NY, USA). In the study, the chi-square test and One-Way Analysis of Variance (ANOVA) were used to assess the homogeneity of the independent variables across groups. The ANOVA and the Kruskal-Wallis H test were used to compare the intragroup mean scores of the intervention and control groups. The paired-samples t-test and the Wilcoxon signed-rank test were used to assess differences in dependent measurements between two groups (12). For data that meet the assumption of normality and are analyzed using parametric tests, the "dz" effect size should be interpreted as follows: $0.2 \leq dz < 0.5$ indicates a small effect, $0.5 \leq dz < 0.8$ indicates a medium effect, and $dz \geq 0.8$ indicates a large effect. Similarly, the η^2 (eta-squared) effect size is recommended to be interpreted as follows: $0.01 \leq \eta^2 < 0.06$ indicates a small effect; $0.06 \leq \eta^2 < 0.14$ indicates a medium effect; and $\eta^2 \geq 0.14$ indicates a large effect (13). Omega-squared (ω^2) is an effect-size measure used as an alternative to eta-squared in ANOVA and provides more reliable estimates, particularly with small sample sizes. The interpretation of ω^2 is as follows: $0.01 \leq \omega^2 < 0.06$ indicates a small effect, $0.06 \leq \omega^2 < 0.14$ a medium effect, and $\omega^2 \geq 0.14$ a large effect (14).

Ethics Statement

Approval to conduct the study was granted by the Clinical Research Ethics Committee of the Süleyman Demirel University Faculty of Medicine (decision no: 22/326, dated: 18.11.2022). Permission to carry out the study at the city hospital was obtained from the Provincial Directorate of Health (decision no: E-16657963-799-206773439, dated: 11.01.2023). Informed consent was obtained from individuals who met the inclusion criteria and agreed to participate in the study. The consent form included information about the study's purpose, duration, data collection procedures, voluntary participation, the right to withdraw at any time, and the confidentiality of their identities.

RESULTS

Except for economic status (p=0.046), other socio-demographic characteristics of the patients were homogeneously distributed across groups (p>0.05) (Table 1). The distribution of socio-demographic characteristics of patients who underwent abdominal surgery, by group, is presented in Table 1.

Except for time elapsed since previous analgesic use (p=0.011), the other clinical characteristics of the patients were similarly distributed across groups (p>0.05). The distribution of clinical characteristics of patients who underwent abdominal surgery, by group, is given in Table 2 below.

The blood pressure measurements of patients who underwent abdominal surgery did not differ significantly between groups at either pre-test or post-test (p=0.830 and p=0.841, respectively). Within-group analyses showed no significant differences over time in any group (p>0.05). Pulse findings did not show statistically significant differences between the groups for pre- and post-test measurements (p=0.825 and p=0.687, respectively). Within-group comparisons revealed a significant increase in pulse values over time in both the VR glasses group (p<0.001; r=0.51, large effect) and the SB group (p<0.001; r=0.57, large effect). A significant increase was also observed in the control group (p=0.015; r=0.34, a moderate effect). Respiratory rate did not show a statistically significant difference between the groups in terms of pre-test and post-test measurements (p=0.714 and p=0.302, respectively). Within-group comparisons found significant increases over time in the VR glasses group (p<0.001; r=0.58, large effect), the SB group (p=0.001; r=0.45, moderate effect), and the control group (p=0.022; r=0.32, moderate effect). Body temperature differed significantly among groups at pre-test and post-test (p=0.032; η^2=0.04, indicating a small effect). Although an overall significant difference was identified, post-hoc analysis revealed no significant pairwise differences between the groups. Within-group comparisons showed a significant increase over time only in the SB group (p=0.004; dz=0.40; small effect), while no significant changes were detected in the other groups (p>0.05). A statistically significant difference in oxygen saturation (SpO_2) was observed between groups during the pre-test (p=0.004), whereas no significant difference was detected during the post-test (p=0.133). Within-group comparisons revealed a significant increase in SpO_2 values over time in both the VR glasses group (p<0.001; r=0.54, large effect size) and the SB group (p<0.001; r=0.62, large effect size), whereas no significant change was observed in the control group (p=0.935). The Comparison of pre-test and post-test mean values of vital signs within and between groups of patients who underwent abdominal surgery is presented in Table 3 (Supplemental Digital Content 1).

A statistically significant difference in pretest pain levels was found among groups of patients who underwent abdominal surgery (p<0.001; η^2=0.14, large effect). This difference was attributable to higher pain levels in the VR and SB groups than in the control group. No significant difference was found between groups in the post-test measurements (p=0.577, η^2=0.01). Within-group comparisons revealed statistically significant decreases in pain levels in both the VR glasses group (p<0.001, dz=0.83, large effect) and the SB group (p<0.001, dz=0.57, moderate effect). In the control group, a significant increase in pain levels was observed (p<0.001; dz=0.82, large effect). Within- and between-group comparisons of pretest and posttest mean scores for pain, fear, satisfaction, and comfort in patients who underwent abdominal surgery are presented in Table 4 (Supplemental Digital Content 2).

Comparison of fear of dressing changes among the groups revealed a statistically significant difference in pretest measurements (p<0.001). This difference was attributed to the significantly higher levels of fear in the VR glasses and SB groups than in the control group (p<0.001). A significant difference between groups was also observed in post-test measurements (p=0.009), apparently driven by higher fear levels in the VR glasses group than in the other groups. Within-group comparisons revealed statistically significant reductions in fear levels for the VR glasses group (p<0.001, r=0.77; large effect), the SB group (p<0.001, r=0.78; large effect), and the control group (p=0.001, r=0.45; medium effect) (Table 4; Supplemental Digital Content 2).

In terms of satisfaction, no statistically significant differences were found between the groups in either the pre-test (p=0.825) or post-test (p=0.687) measurements. However, within-group comparisons showed significant increases in satisfaction levels in the VR glasses group (p<0.001, r=0.54, large effect) and the SB group (p<0.001, r=0.62, large effect). In contrast, no significant change in satisfaction was observed in the control group (p=0.935; Table 4; Supplemental Digital Content 2).

When the comfort scores were compared between the groups, no statistically significant difference was found in the pre-test measurements (p=0.398). However, a significant difference was found in the post-test measurements (p<0.001). This difference was attributable to significantly higher comfort levels in the VR glasses and SB groups compared with the control group. Within-group comparisons showed a statistically significant increase in comfort levels in the VR glasses group (p<0.001, r=0.81, large effect), in the ST group (p<0.001, r=0.80, large effect), and in the control group (p<0.001, r=0.50, large effect) (Table 4; Supplemental Digital Content 2).

No statistically significant difference in state anxiety was found in the pre-test measurements (p=0.268, ω^2=0.01). Post-test measurements showed a significant difference between

Table 1. Comparison of the distribution of socio-demographic characteristics of patients underwent abdominal surgery by groups (n=156)

Variables	Virtual reality glasses group	Stress ball group	Control group		
	n=52	n=52	n=52	Test significance	
	M ± SD	M ± SD	M ± SD		
Age Min-Max	56.40±16.77 18-88	57.19±16.07 21-83	54.88±17.19 24-81	F=0.257	p=0.774
	n (%)	n (%)	n (%)	χ^2	p
Gender					
Female	29 (55.8)	29 (55.8)	30 (57.7)	0.052	0.974
Male	23 (44.2)	23 (44.2)	22 (42.3)		
Marital status					
Single	8 (15.4)	7 (13.5)	7 (13.5)	0.106	0.948
Married	44 (84.6)	45 (86.5)	45 (86.5)		
Educational status					
Literate	3 (5.8)	1 (1.9)	6 (11.5)	4.665	0.323
Below undergraduate	42 (80.8)	41 (78.8)	39 (75.0)		
Undergraduate level and above	7 (13.5)	10 (19.2)	7 (13.5)		
Employement status					
Homemaker	27 (51.9)	19 (36.5)	26 (50.0)	4.437	0.350
Retired	16 (30.8)	16 (30.8)	15 (28.8)		
Unemployed	9 (17.3)	17 (32.7)	11 (21.2)		
Perceived economic status					
Income less than expense	12 (23.1)	10 (19.2)	18 (34.6)	**9.673**	**0.046**
Income equal to the expense	32 (61.5)	32 (61.5)	33 (63.5)		
Income higher than expense	8 (15.4)	10 (19.2)	1 (1.9)		
Chronic disease status					
Yes	25 (48.1)	27 (51.9)	29 (55.8)	0.616	0.735
No	27 (51.9)	25 (48.1)	23 (44.2)		

SD: Standard deviation, n: number, %: Percentage, Min: Minimum value, Max: Maximum value, χ^2: Pearson chi-square test value, M: Mean.

groups (p<0.001, ω^2 0.15, large effect). It was determined that this difference was caused by higher state anxiety levels in the control group than in the VR and SB groups. Statistically significant decreases in state anxiety levels were observed in within-group comparisons for the VR glasses group (p<0.001, dz=2.37, large effect), the SB group (p<0.001, dz=1.77, large effect), and the control group (p<0.001, dz=0.94, large effect). No significant difference was detected between groups in post-test state anxiety measurements (p=0.336, ω^2=0.01). This finding suggests a similar distribution of trait anxiety levels among the groups. The comparison of pretest and posttest mean scores of state and trait anxiety, within and between groups of patients who underwent abdominal surgery, is presented in Table 5 (Supplemental Digital Contents 3 and 4).

Table 2. Comparison of the distribution of clinical characteristics of patients who underwent abdominal surgery (n=156)

Variables	**Virtual reality glasses group**	**Stress ball group**	**Control group**		
	n=52	**n=52**	**n=52**	**Test significance**	
	M ± SD	**M ± SD**	**M ± SD**		
Pain intensity Min-Max	5.15±1.42 2-8	5.42±1.47 2-9	4.96±1.19 2-8	F=1.498	p=0.227
Duration since the previous analgesic dose/hour Min-Max	8.88±1.08 7-10	8.88±1.06 7-10	8.27±1.39 7-10	**F=4.675**	**p=0.011**
Wound size/cm Min-Max	4.86±2.25 3-10	6.07±3.15 3-15	5.05±2.50 3-15	H=5.485	p=0.064
Qualitative characteristics	**n (%)**	**n (%)**	**n (%)**	**χ^2**	**p**
Medical diagnosis					
Inguinal hernia	19 (36.5)	25 (48.1)	19 (36.5)	-	-
Umbilical hernia	0 (0.0)	2 (3.8)	2 (3.8)		
Sleeve gastrostomy	0 (0.0)	3 (5.8)	1 (1.9)		
Appendicitis	1 (1.9)	2 (3.8)	2 (3.8)		
Cholelithiasis	27 (51.9)	13 (25.0)	24 (46.2)		
Ventral hernia	3 (5.8)	3 (5.8)	1 (1.9)		
Incisional hernia	2 (3.8)	3 (5.8)	2 (3.8)		
Ileus	0 (0.0)	1 (1.9)	0 (0.0)		
Colon CA	0 (0.0)	0 (0.0)	1 (1.9)		
Surgical intervention type					
Urgent surgery	1 (1.9)	4 (7.7)	3 (5.8)	1.845	0.398
Elective surgery	51 (98.1)	48 (92.3)	49 (94.2)		
ASA* level before surgical intervention					
1	4 (7.7)	4 (7.7)	7 (13.5)	5.710	0.222
2	45 (86.5)	38 (73.1)	38 (73.1)		
3	3 (5.8)	10 (19.2)	7 (13.5)		
Anesthesia					
General	34 (65.4)	25 (48.1)	33 (63.5)	3.868	0.145
Spinal	18 (34.6)	27 (51.9)	19 (36.5)		
Surgical history					
Yes	24 (46.2)	28 (53.8)	30 (57.7)	1.440	0.487
No	28 (53.8)	24 (46.2)	22 (42.3)		
General pain intensity of the surgical wound					
Mild	9 (17.3)	7 (13.5)	10 (19.2)	3.450	0.485
Discomforting	43 (82.7)	42 (80.8)	40 (76.9)		
Severe/Intense	0 (0.0)	3 (5.8)	2 (3.8)		

Table 2. Continued					
Variables	**Virtual reality glasses group**	**Stress ball group**	**Control group**		
	n=52	**n=52**	**n=52**	**Test significance**	
	M ± SD	**M ± SD**	**M ± SD**		
Pain frequency at the surgical wound					
Occasionally	8 (15.4)	7 (13.5)	2 (3.8)	8.375	0.212
Sometimes	39 (75.0)	39 (75.0)	45 (86.5)		
Frequently	5 (9.6)	4 (7.7)	5 (9.6)		
Generally	0 (0.0)	2 (3.8)	0 (0.0)		
Duration of postoperative wound pain					
Nightlong	0 (0.0)	0 (0.0)	1 (1.9)	4.947	0.293
During daily activities	38 (73.1)	45 (86.5)	40 (76.9)		
During the rest	14 (26.9)	7 (13.5)	11 (21.2)		
Analgesic use					
Yes	52 (100.0)	52 (100.0)	52 (100.0)	-	-
Dressing change experience					
Yes	25 (48.1)	29 (55.8)	29 (55.8)	0.824	0.662
No	27 (51.9)	23 (44.2)	23 (44.2)		
Dressing care knowledge					
Yes	22 (42.3)	28 (53.8)	29 (55.8)	2.438	0.656
No	28 (53.8)	23 (44.2)	22 (42.3)		
Partially	2 (3.8)	1 (1.9)	1 (1.9)		

M: Mean, SD: Standard deviation, n: Number, %: Percentage, Min: Minimum value, Max: Maximum value, χ2: Pearson chi-square test value, H: Kruskal-Wallis H test value, ASA: American Society of Anesthesiologists classification.

Table 3. Comparison of pre-test and post-test mean values of vital signs within and between groups of patients who underwent abdominal surgery (n=156)

Measurements	**Virtual reality glasses group**		**Stress ball group**		**Control group**		**Comparisons between groups**			
	n=52		**n=52**		**n=52**		**Test**			
Blood pressure	**M ± SD**	**M (IQR)**	**M ± SD**	**M (IQR)**	**M ± SD**	**M (IQR)**	**Significance**		**ES**	**Difference**
Pre-test	121.52±14.89[a]	121 (20)	120.59±17.74[a]	118 (24)	122.50±15.14[a]	121 (20)	F=0.187	p=0.830	η^2=0.00	-
Post-test	122.40±14.82[a]	121 (20)	120.84±17.48[a]	121 (20)	122.47±15.38[a]	121 (20)	F=0.173	p=0.841	η^2=0.00	-
Test	t=-1.944		t=-0.761		t=0.095					
Significance	p=0.057		p=0.450		p=0.925					
ES	dz=0.27		dz=0.11		dz=0.01					
Pulse										
Pre-test	75.02±9.79[a]	72 (13)	74.31±10.46[a]	72 (12)	74.50±11.38[a]	76 (17)	H=0.385	p=0.825	-	-
Post-test	77.25±9.35[a]	76 (12)	76.33±10.63[a]	76 (11)	75.54±10.99[a]	76 (18)	H=0.752	p=0.687	-	-
Test		Z=3.672		Z=4.146		Z=2.441				
Significance		p<0.001		p<0.001		0.015				
ES		r=0.51		r=0.57		r=0.34				
Respiratory rate										
Pre-test	14.46±2.04 [a]	14 (2)	14.33±1.99[a]	14 (2)	14.40±2.75[a]	14 (4)	H=0.674	p=0.714	-	-
Post-test	15.46±2.35[a]	16 (4)	15.12±2.04[a]	16 (2)	14.81±2.69[a]	14 (6)	H=2.393	p=0.302	-	-
Test		Z=4.218		Z=3.247		Z=2.297				
Significance		p<0.001		p=0.001		p=0.022				
ES		r=0.58		r=0.45		r=0.32				

Table 3. Continued

Measurements	Virtual reality glasses group		Stress ball group		Control group		Comparisons between groups			
	n=52		n=52		n=52		Test			
Body temperature	**M ± SD**	**M (IQR)**	**M ± SD**	**M (IQR)**	**M ± SD**	**M (IQR)**	**Significance**		**ES**	**Difference**
Pre-test	36.73±0.26[a]	37 (0)	36.63±0.26[a]	37 (0)	36.63±0.20[a]	37 (0)	F=3.522	p=0.032	η^2=0.04	-
Post- test	36.74±0.25[a]	37 (0)	36.69±0.19[a]	37 (0)	36.66±0.18[a]	37 (0)	F=2.198	p=0.115	η^2=0.03	-
Test	t=-0.393		t=-3.060		t=-1.738					
Significance	p=0.696		p=0.004		p=0.088					
ES	dz=0.07		dz=0.40		dz=0.23					
Oxygen saturation (SpO_2)										
Pre-test	97.31±2.36[ab]	98 (3)	96.88±2.23[b]	97 (2)	98.31±1.70	99 (4)	H=11.158	p=0.004	-	[a]>[b]
Post-test	97.90±1.99[a]	98 (3)	97.63±1.93[a]	98 (2)	98.31±1.81[a]	99 (3)	H=4.037	p=0.133	-	-
Test		Z=3.894		Z=4.435		Z=-0.082				
Significance		p<0.001		p<0.001		p=0.935				
ES		r=0.54		r=0.62		r=0.01				

Mean: M, SD: Standard deviation, n: Number, M (IQR): Median (75th and 25th percentiles), IQR: Interquartile range, t: Paired sample t-test value, F: The One-Way Analysis of variance test value (ANOVA), H: Kruskal-Wallis H test value, Z: Wilcoxon signed-rank test value, ES (r, η^2, dz): Effect size, [a, b]: Different superscript letters indicate significant differences between groups (p<0.05).

Table 4. Within- and between-group comparisons of pretest and posttest mean scores for pain, fear, satisfaction, and comfort in patients who underwent abdominal surgery (n=156)

Measurements	Virtual reality glasses group		Stress ball group		Control group		Comparisons between groups			
	n=52		n=52		n=52		Test			
Pain	**M ± SD**	**M (IQR)**	**M ± SD**	**M (IQR)**	**M ± SD**	**M (IQR)**	**Significance**		**ES**	**Difference**
Pre-test	4.77±1.98[a]	5 (4)	4.79±1.89[a]	5 (3)	3.25±1.62[b]	3 (2)	F=12.022	p<0.001	η^2=0.14	[a]>[b]
Post-test	4.19±1.67[a]	4 (2)	3.87±1.85[a]	4 (2)	3.88±1.82[a]	4 (2)	F=0.552	p=0.577	η^2=0.01	-
Test	t=5.979		t=4.142		t=-5.961					
Significance	p<0.001		p<0.001		p<0.001					
ES	dz=0.83		dz=0.57		dz=0.82					
Fear										
Pre-test	5.87±3.42	7 (6)[a]	5.21±3.44	5 (6)[a]	2.56±2.78	2 (5)[b]	H=26.087	p<0.001	-	[a]>[b]
Post-test	1.94±2.48	1 (4)[a]	0.65±1.28	0 (1)[b]	1.25±2.18	0 (2)[ab]	H=9.501	p=0.009	-	[a]>[b]
Test		Z=-5.570		Z=-5.659		Z=-3.270				
Significance		p<0.001		p<0.001		p=0.001				
ES		r=0.77		r=0.78		r=0.45				
Satisfaction										
Pre-test	8.58±1.13	9 (1)[a]	9.13±0.89	9 (1)[a]	9.08±0.74	9 (1)[a]	H=0.385	p=0.825	-	-
Post- test	10.00±0.00	10 (0)[a]	10.00±0.00	10 (0)[a]	9.25±0.88	9 (1)[a]	H=0.752	p=0.687	-	-
Test		Z=3.894		Z=4.435		Z=-0.082				
Significance		p<0.001		p<0.001		p=0.935				
ES		r=0.54		r=0.62		r=0.01				
Comfort										
Pre-test	6.96±1.68	7 (2)[b]	7.08±1.85	7 (3)[b]	6.37±2.67	6 (5)[b]	H=1.840	p=0.398	-	-
Post-test	9.25±1.87	10 (1)[a]	9.23±1.21	10 (1)[a]	7.40±2.61	8 (5)[b]	H=21.993	p<0.001	-	[a]>[b]
Test		Z=5.850		Z=5.798		Z=3.609				
Significance		p<0.001		p<0.001		p<0.001				
ES		r=0.81		r=0.80		r=0.50				

SD: Standard deviation, n: Number, M (IQR): Median (75th and 25th percentiles), IQR: Interquartile range, t: Paired sample t-test value, F: The One-Way Analysis of variance test value (ANOVA), H: Kruskal-Wallis H test value, Z: Wilcoxon signed rank test value, ES (r, η^2, dz): Effect size, [a, b]: Different superscript letters indicate significant differences between groups (p<0.05), M: Mean.

Table 5. Comparison of pretest and posttest mean scores of state and trait anxiety findings within and between groups in patients who underwent abdominal surgery (n=156)

Measurements	Virtual reality glasses group	Stress ball group	Control group	Comparisons between groups			
	n=52	n=52	n=52	Test			
Stait anxiety	M ± SD	M ± SD	M ± SD	Significance		ES	Difference
Pre-test	43.19±5.39[b]	42.69±8.55[b]	40.98±8.13[b]	W=1.336	p=0.268	ω^2=0.01	-
Post-test	30.02±4.66[b]	30.42±5.35[b]	35.71±7.46[a]	W=11.638	p<0.001	ω^2=0.15	[a]>[b]
Test	t=17.102	t=12.791	t=6.788				
Significance	p<0.001	p<0.001	p<0.001				
ES	dz=2.37	dz=1.77	dz=0.94				
Trait anxiety							
Pre-test	30.73±5.38	32.15±8.27	32.10±4.49	W=1.103	p=0.336	ω^2=0.01	-

SD: Standard deviation, n: Number, t: Paired sample t-test value, W: Welch test value, ES: Effect size, ω^2: Omega-squared effect size value, dz: Effect size value for t-test. [a, b]: Different superscript letters indicate significant differences between groups (p<0.05), M: Mean.

DISCUSSION

The study revealed that the use of VR glasses and SB during dressing changes did not produce statistically significant differences in vital signs between groups of patients who underwent abdominal surgery. However, some remarkable findings were observed when each group was assessed individually. In the intervention groups (VR and SB), significant increases were observed pulse rate and SpO_2 during dressing changes. Both the intervention and control groups showed significant increases in respiratory rate over time. Only within-group comparisons of the SB group showed a significant increase in fever. When blood pressure was examined, no significant differences were found either within or between the groups. Based on these findings, a significant within-group increase indicates that the applications affect physical responses. Pain, anxiety, fear, and similar conditions experienced during invasive procedures such as dressing changes may activate the sympathetic nervous system, leading to increases in pulse rate, respiratory rate, and blood pressure (15). Ding et al. (4) reported an increase in pulse rate during the first postoperative dressing among hemorrhoid patients in both the VR and control groups; however, no significant difference was found between the groups. In a study conducted during another intervention, namely a splinting procedure in children, the VR glasses group showed lower intra-procedural and post-procedural pulse rates. In contrast, oxygen saturation levels during the procedure were higher than pre-procedural values (16). A study conducted in patients undergoing colonoscopy revealed that the use of VR glasses significantly decreased systolic blood pressure and respiratory rate, and increased oxygen saturation (17). In another study conducted during the transrectal prostate biopsy, it was found that VR and SB applications caused significant decreases in diastolic blood pressure, pulse, and respiratory rate, and a significant increase in oxygen saturation (9). The use of an anti-SB during inferior alveolar nerve block injection did not cause significant changes in vital signs, including among individuals under 35 years of age and in both genders (18). Studies have shown that VR and SB during procedural interventions have varied effects on hemodynamic parameters; however, further research is needed to evaluate their impact on vital signs during dressing procedures.

Although no significant differences were found between the groups in post-test pain measurements, pre-test measurements revealed that the intervention groups had statistically significantly higher pain levels. Within-group comparisons revealed a statistically significant decrease in pain levels in the intervention groups. The use of VR glasses and a SB appears to have a positive effect on patients' pain levels. In the present study, patients generally reported moderate pain at their surgical wound sites. Regarding the time elapsed since the previous analgesic use, patients in the intervention groups received pain medication significantly earlier than those in the control group. Among patients with wounds, dressing changes are one of the most common causes of pain (19). A study involving burn patients of various ages showed that use of VR glasses during dressing procedures significantly reduced pain levels (20). Many studies have emphasized that the distracting effect of VR glasses can reduce pain perception in both children and adults during dressing changes (2,4,21-24). In a previous study, pain levels in patients who underwent abscess drainage were assessed before dressing changes, at multiple time points during dressing changes, and after dressing changes. No statistically significant difference was found in post-dressing pain measurements between the group receiving VR combined with analgesics and the control group receiving analgesics alone. In contrast, pain levels measured during the dressing change were reported to be lower in the group receiving VR and analgesics compared with the control group (25). According to a systematic review and meta-analysis, use of VR glasses significantly reduced pain intensity during wound care procedures in adults across all study designs. Also, it enhanced patients' overall wound care experience (26). The pain experienced during clinical procedures

is known as procedural pain (17). Pain is a subjective and multidimensional phenomenon composed of sensory, cognitive, affective, and socio-cultural components (27). The literature indicates that informing patients about the procedure, ensuring their comfort and addressing pain throughout the process, and making them aware of supportive methods, such as distraction or music, to alleviate discomfort or anxiety may reduce pain intensity or prevent pain during dressing changes (28,29). Examination of dressing knowledge in this study showed that 42.3% of the VR group, 53.8% of the SB group, and 55.8% of the control group were familiar with dressing. Psychosocial factors, such as age, gender, culture and traditions, anxiety and depression, and environmental factors, such as resources and the setting and timing of the procedure, may affect patients' unique pain experience (19). Because pain is multidimensional, conducting research with diverse sample groups during dressing procedures will yield more definitive information about the use of VR and SB in wound care.

Among patients who underwent abdominal surgery, pre-test measurements during dressing changes showed that levels of fear in the intervention groups were significantly higher. At post-test, fear levels in the VR group were higher than those in the other groups. In within-group comparisons, significant decreases in fear levels were observed in both the intervention and control groups. This finding suggests that VR and SB may initially increase patient awareness or trigger procedural anxiety because they are unfamiliar to the patient. In this context, VR and SB appear to reduce fear levels throughout the process. Studies have shown that using VR glasses during dressing procedures in pediatric patients reduces fear (30,31). A study of adult diabetic patients reported a decrease in fear of self-injection and self-testing following use of VR and ice (32). On the other hand, in studies involving children or adults, SB application had no positive effect on fear during procedures such as intravenous catheterization (33,34), drawing blood (35,36), and endoscopy (37). Fear is a sudden, undesirable behavioral and emotional response to a real or imagined threat. In healthcare settings, this response becomes particularly pronounced during medical procedures; individuals may develop a fear of such procedures when interacting with healthcare professionals, undergoing medical interventions, or being in the hospital environment. Fear of medical procedures reduces individuals' involvement in the treatment process and negatively affects healthcare delivery (38). In this context, the significant decrease in fear levels observed in both the virtual-reality and stress-ball intervention groups suggests that these distraction techniques may reduce fear of medical procedures. This decrease in fear levels can be explained by a mechanism that diverts the individual's attention from painful stimuli during medical procedures, thereby soothing and regulating emotional responses. However, the high fear levels observed in the intervention groups during the pre-test, the significant decrease during the process, and the elevated fear levels in the VR group at the post-test suggest that further research is needed regarding the use of VR and stress-ball interventions for this variable.

The study found no statistically significant difference in post-test measurements of patient satisfaction between groups of patients who underwent abdominal surgery. However, in within-group comparisons, satisfaction increased in the groups that received VR and SB, while no significant difference in satisfaction was observed in the control group. These results suggest that both distracting interventions have a positive effect on patient satisfaction. A study conducted during dressing changes in burn patients across a wide age range revealed a positive effect on patient satisfaction (20). Hudson et al. (39) reported that the use of distraction techniques—including VR glasses, SBs, nurse interaction, and watching DVDs—during varicose vein treatment did not produce significant differences in patient satisfaction among the groups. Studies have indicated that using smart glasses during procedures such as peripheral intravenous catheter insertion (40,41), blood sampling (42,43), and arteriovenous fistula cannulation (44) increases patient satisfaction. However, to evaluate such interventions effectively, studies are needed that focus on different patient populations, diverse cultural contexts, and long-term effects.

An analysis of the research findings indicates that during dressing changes for patients who underwent abdominal surgery, comfort levels were higher in the intervention groups receiving VR glasses and SB applications than in the control group. According to Kolcaba's Theory of Comfort, when an individual's comfort needs are met, they experience a sense of calmness, peace, relaxation, and the ability to cope with challenges. Kolcaba states that comfort must be addressed in four interrelated contexts: Physical, socio-cultural, psychospiritual, and environmental, all of which influence one another (45). In this context, the interventions applied to patients in the VR and SB groups are thought to have helped them cope better with the dressing procedure, providing a sense of relief. These findings suggest that VR glasses and SB may serve as comfort-enhancing interventions during dressing changes.

Among patients who underwent abdominal surgery, anxiety was lower in the intervention group that received VR and SB than in the control group. A study found that the combined use of VR glasses and analgesics during dressing changes significantly reduced anxiety in pediatric patients (46). Studies have shown that the use of VR during dressing changes not only reduces anxiety levels but may also shorten the duration of the procedure (30,31). In another study of adult diabetic patients, VR and ice application reduced anxiety levels related to self-injection and the testing process (32). VR glasses have a significant effect on anxiety in children and adults during various procedures, including splint applications (16), venous blood collection (47), fluoroscopy-guided interventional

procedures (48), and blood collection procedures (35). Hudson et al. (39) found that distracting techniques (VR glasses, SB, nurse interaction, watching a DVD) during varicose vein treatment reduced intraoperative anxiety. In a study comparing SB and VR during peripheral catheterization, both methods reduced patients' anxiety levels (49). In a study of individuals undergoing endoscopy, use of a SB significantly reduced post-procedure anxiety scores (37). However, unlike other findings, the use of ST during lipoma excision under local anesthesia has been reported to have no significant effect on anxiety (50). Consistent with these results, using VR glasses (providing visual and auditory stimulation) and SB emerge as effective strategies for reducing patient anxiety and distraction during dressing procedures.

Study Limitations

The presence of varied medical diagnoses among patients who underwent abdominal surgery limited the homogeneity of the sample. Since most patients were unfamiliar with VR glasses, introducing the device to them proved challenging. Another limitation of the study was that the video presented through the VR glasses was standardized (the same content was shown to all patients) and did not vary according to individual interests.

CONCLUSION

During dressing changes for patients who underwent abdominal surgery, anxiety was lower in the intervention group using VR and SB than in the control group. The comfort levels were higher in the VR and SB groups than in the control group. Fear levels in the VR glasses group regarding dressing changes were higher than in other groups. No differences between the groups were found in pain, vital signs, or satisfaction. In line with these results, integrating VR glasses and stress-ball use into clinical practice for dressing changes in patients undergoing abdominal surgery is recommended to enhance patient comfort and reduce anxiety. To clarify the effectiveness of VR glasses and SBs in adult patients undergoing dressing procedures with respect to the study variables and to obtain evidence-based information, further research using different samples and methods (such as various educational materials and distraction techniques) is recommended.

Ethics

Ethics Committee Approval: Approval to conduct the study was granted by the Clinical Research Ethics Committee of the Süleyman Demirel University Faculty of Medicine (decision no: 22/326, dated: 18.11.2022). Permission to carry out the study at the city hospital was obtained from the Provincial Directorate of Health (decision no: E-16657963-799-206773439, dated: 11.01.2023).

Informed Consent: Informed consent was obtained from individuals who met the inclusion criteria and agreed to participate in the study.

Acknowledgments

We would like to thank all the patients who volunteered to participate in the study.

Footnotes

Author Contributions

Concept - Z.Y., A.B.; Design - Z.Y., A.B.; Data Collection or Processing - Z.Y., A.B.; Analysis or Interpretation - Z.Y., A.B.; Literature Search - Z.Y., A.B.; Writing - Z.Y., A.B.

Conflict of Interest: No conflict of interest was declared by the authors.

Financial Disclosure: This research was supported by the Süleyman Demirel University Scientific Research Projects Coordination Unit with project number TYL-2024-9227.

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