

Guided Relaxation-Based Virtual Reality to Help Manage Pain and Anxiety in Children and Adolescents Following Surgery

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Introduction

- Virtual Reality (VR) offers an innovative method to deliver nonpharmacologic pain management.
- Distraction-based VR (VR-D) uses immersive games to redirect attention and has shown short-term decreases in pain in various settings.¹⁻⁴
- To create lasting pain reduction, VR-based strategies need to go beyond distraction.⁵
- **Our goal was to assess the use of VR-guided relaxation (VR-GR) to decrease acute postoperative pain and anxiety in children and adolescents.**

Methods

Patients: 18 patients were included in analysis (Table 1). Eligible patients were aged 7-21 years and followed by the Acute Pain Service after surgery at Cincinnati Children's Hospital Medical Center. Patients were excluded if they had a history of developmental delay, neurological or uncontrolled psychiatric conditions, and/or recent head/neck surgery.

Study Design: Patients were approached in the postoperative period. Following consent/assent, baseline assessment included completion of the Pain Catastrophizing Scale for Children (PCS-C) and the Child Anxiety Sensitivity Index (CASI). Baseline pain and anxiety scores were assessed with the numerical rating scale (NRS) immediately before VR. Post-VR scores were reported immediately, 15, and 30 minutes after the VR experience. Pain and anxiety scores at each time point were compared to baseline using ANOVA.

Virtual Reality Device and Games: Patients used the Mindful Aurora application for 10 minutes on the Starlight Xperience device, which consists of a wireless head-mounted display and remote (Figure 1). This relaxation application facilitates directed slow breathing with a virtual nature scene (Figure 2).

Starlight Xperience™



Figure 1. Starlight Xperience VR Device



Figure 2. Mindful Aurora Application

Table 1. Demographic data

Age (Mean ± SD), years	12.5 ± 2.9
Gender Male/Female (n)	12/6
Surgery Type (%)	
Abdominal	33.3%
Pectus Repair	38.9%
Major Orthopedic	16.7%
Other	11.1%
Race (%)	
Caucasian	77.8%
Non-Caucasian	22.2%
Psychological Factors – mean (SD)	
PCS-C	20.8 (12.1)
CASI	29.4 (6.0)
Medication with 4 hours of visit (%)	
Opioid	83.3%
Benzodiazepine	55.6%

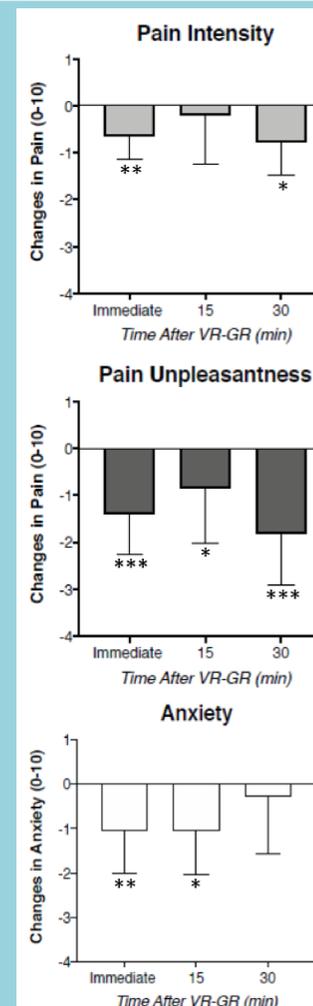
References

1. Malloy KM, et al. *Clin Psychol Rev*. 2010;30(8):1011-1018
2. Li A, et al. *Pain Manag*. 2011;1(2):147-157
3. Indovina P, et al. *Clin J Pain*. 2018;34(9):858-877
4. Mallari B, et al. *J Pain Res*. 2019;12:2053-2085
5. Gupta A, et al. *Pain Med*. 2018;19(1):151-159

Figure 3. Changes in pain and anxiety following VR-GR from baseline.

Children and adolescents underwent 10 minutes of VR-GR. Pain and anxiety scores were collected before and following (up to 30 minutes) the VR-GR session. Pain unpleasantness had the largest reduction following VR-GR.

* $p < 0.05$, ** $p < 0.01$, *** $p \leq 0.001$



Results

- **Pain Intensity:** VR-GR showed moderate effects on pain intensity ($F_{(3,51)} = 3.04$, $p=0.03$, partial $\eta^2 = 0.15$). Post-hoc analysis revealed a reduction in pain intensity immediately following the VR-GR session (NRS decrease 0.94 points, $p=0.002$) and at 30 minutes (NRS decrease 1.0 points, $p=0.028$).
- **Pain Unpleasantness:** VR-GR showed large effects on pain unpleasantness ($F_{(3,51)} = 13.5$, $p < 0.001$, partial $\eta^2 = 0.32$). Pain unpleasantness decreased immediately (NRS decrease 1.5 points, $p < 0.001$) and remained lower both 15- (NRS decrease 1.1 points, $p=0.025$) and 30-minutes (NRS decrease 2.1 points, $p < 0.001$) post-VR exposure.
- **Anxiety:** VR-BF showed effects on anxiety ($F_{(3,51)} = 2.61$, $p=0.06$, partial $\eta^2 = 0.13$). Post-hoc analysis revealed reduction in anxiety (NRS decrease 1 point, $p=0.009$) immediately ($p=0.008$) following the VR-GR session.
- **Impact of Covariates:** Demographic factors, medication administration, and trait measures did not impact these results.

Conclusions

- VR-GR is effective at producing transient changes in pain and anxiety in the immediate term in children and adolescents with acute pain following surgery, with trends towards sustained effects at 30 minutes.
- These effects appeared to be stronger in pain unpleasantness, suggesting reductions in the emotional aspects of pain might be a target of VR interventions.
- Additional research regarding the (a) delivery, (b) content, and (c) duration of the VR intervention using relaxation may be needed to optimize lasting reductions in acute postoperative pain and anxiety.