

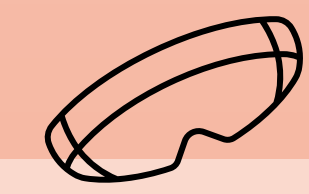
Virtual Reality's Impact on Pediatric Procedural Pain and Anxiety

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Background & Significance



- When children experience pain during a routine procedure, it is often accompanied by anxiety and fear. As children age into adulthood, experiences with uncontrolled pain can contribute to increased anxiety around future medical procedures and doctor's visits, making them less likely to seek appropriate care as adults (Hsu et al., 2022).
- Current practice for pain control in children undergoing basic needle procedures involves using topical anesthetics and nonpharmacologic options like watching television, listening to music, or placing a Buzzy Bee vibrating ice pack near the source of the painful stimulus (Gold et al., 2021).
- The concern is that these distraction techniques do not address the anxiety and fear that can arise prior to a medical procedure, especially one that is routine where the child knows to expect pain. Distraction techniques like watching television and playing music are passive forms of distraction that do not always successfully draw the child's attention away from the pain source.
- An evidence synthesis was conducted to answer the following PICOT question: ***In pediatric patients over 4 undergoing routine procedures, does using virtual reality (VR) as a distraction technique compared to traditional methods impact pain and anxiety levels?***



Methods

- An initial database search was conducted with PubMed using key terms (virtual reality AND (procedur* pain) AND (children OR pediatric). The "full text" option was selected, and the publication dates were set between 2019 and 2024, yielding 180 results.
- After selecting "randomized controlled trial," "clinical trial," and adjusting the search terms to include NOT (dental) and NOT (pilot), 45 results remained for further review.
- After evaluating these titles, four were eliminated based on the timing of the tested interventions and 10 studies were eliminated because the primary interventions and sample populations were irrelevant to the PICOT question. Five were removed because procedural pain was not a primary dependent variable and four more were eliminated because they focused on more than one primary intervention. Seven studies were also removed for sampling patients from the emergency department.
- Abstracts for the remaining 15 articles were reviewed and five were chosen to proceed to a full-text review. These five studies were the best fit to address the PICOT question.

Evidence Summary

Consistencies

- All five studies evaluated are Level 2 randomized controlled or clinical trials (Melnyk & Fineout-Overholt, 2019) and used convenience sampling to recruit eligible pediatric patients above the age of 4 already scheduled for routine, needle procedures.
- The studies by Gold et al. (2019), Hsu et al. (2022), and Wong & Choi (2023) used the Wong-Baker FACES Pain Scale or the Faces Pain Scale-Revised (FPS-R) to measure pediatric pain levels. The other two studies by Hoag et al. (2022) and Walther-Larsen et al. (2019) measured pain with the Visual Analog Scale (VAS).
- Based on statistically significant findings, researchers Gold et al. (2019), Hsu et al. (2022), and Wong & Choi (2023) concluded that immersive VR is an effective strategy to reduce self-reported pain and anxiety for pediatric patients.

Inconsistencies

- In Hoag et al. (2022), researchers did not use the standard of care (SOC) as the control but instead tested guided imagery (GI) against virtual reality. Both groups of participants underwent GI and VR and the order in which each group received the interventions was randomized.
- In the Walther-Larsen et al. (2019) study, researchers used patient satisfaction on a 0 out of 100 scale as an indirect measure of anxiety rather than measuring patient anxiety directly.
- Walther-Larsen et al. (2019) also maintained the SOC for both groups, including position changes and topical numbing cream, and compared a 2D to a 3D intervention. No statistically significant difference was found between the groups, likely because the SOC was still provided for all participants and the distraction interventions were not well challenged to mitigate pain.
- Wong & Choi (2023) was the only study to use objective measures to track pain and anxiety alongside the self-reported subjective measures that the other four studies used. These objective measures included tracking the patient's heart rate during the interventions and checking salivary cortisol levels 10 minutes before and 30 minutes after each procedure.

Evidence Table

Authors	Level of Evidence (Melnyk & Fineout-Overholt)	Type of Study	Sample Size	Methods	Results
Gold et al., 2021	2	Prospective Randomized Clinical Trial	N = 107 Standard of Care (SOC) = 54 Virtual Reality (VR) Intervention = 53	Before and after the PIVC procedures, pain levels were measured using Faces Pain Scale – Revised (FPS-R) and anxiety levels were measured using the Visual Analog Scale (VAS).	For patients in the VR intervention group, patient, caregiver, and clinician-reported FPS-R scores were significantly lower post-procedure than for patients in the control group (p=.002, p=.04, and p<.001). Patient- and clinician-reported anxiety scores were also statistically lower for VR patients (p<.001 and p=.002).
Hoag et al., 2022	2	Randomized Controlled Trial	N = 67 Group 1 – Guided Imagery (GI) first, then VR = 30 Group 2 – VR first, then GI = 37	The Pain Catastrophizing Scale (PCS) was used to assess perception of pain pre-procedure, and the VAS was used to assess pain post-procedure. The Children's Emotional Manifestation Scale (CEMS) measured distress during each procedure. State and trait anxiety was measured pre-procedure with the State-Trait Anxiety Inventory (STAI).	No significant difference was found between VR and GI interventions in pre- and post-procedure state anxiety scores (pre: p=.24, post: p=.44). Comparing pre- to post-procedure for the VR intervention, there was a statistically significant reduction observed in state anxiety (p<.001) and it was found to be significantly related to procedural pain scores.
Hsu et al., 2022	2	Randomized Controlled Trial	N = 134 Educational Photo Book = 65 VR Play = 69	Pain was assessed using the Wong-Baker FACES Pain Rating Scale post-procedure and fear was measured with the Children's Fear Scale (CFS) pre- and post-procedure for the child and only post-procedure for the caregiver.	The VR group had a statistically significant reduction in children's pain (p=.028) and fear (p=.004), as did their caregivers' scores for pain and fear (p<.001). The time needed for each IV placement did not differ significantly between groups (p=.772).
Walther-Larsen et al., 2019	2	Randomized Clinical Trial	N = 64 SOC = 32 VR = 32	Pain scores were measured using the VAS 15 minutes post-procedure, as were patient satisfaction scores, which were measured using a 0 to 100 scale.	There was no statistically significant difference between groups for pain scores (p=.23). Patients in both groups reported statistically similar levels of satisfaction with VR and SOC distraction techniques (p=.82). There was a borderline significant difference in favor of the VR group when participants were asked if they would use the intervention again (p=.05).
Wong & Choi, 2023	2	Randomized Clinical Trial	N = 149 SOC only = 74 SOC + VR = 75	The FPS-R measured child-reported pain. The VAS measured child-reported anxiety for children aged 4 to 7. The Chinese State Anxiety Scale for Children (CSAS-C) measured child-reported anxiety for children between 8 and 12. Heart rates were measured with automatic monitors and stress was measured using a salivary cortisol assay. Outcomes were evaluated 10 minutes before, during, right after, and 30 minutes after each venipuncture procedure.	Immediately following the interventions, the immersive VR group reported significantly less pain (p<.001) and anxiety (p=.03) than the SOC control group. IVR took significantly less time statistically than the SOC interventions (p=.03). Staff satisfaction scores for the IVR group were also statistically higher (p=0.3). Statistical significance was not reached for heart rate and stress measures.

Summary & Conclusion

- Virtual reality involves placing goggles over the patient's eyes, immersing them in a digitally enhanced three-dimensional world. It has the potential to distract a child more effectively from a painful stimulus by actively immersing them in an environment that mimics reality and, in some cases, by allowing them to interact with what they see (Hoag et al., 2022).
- Introducing this distraction technique early in the procedure process can help to relieve some of the building fear and anxiety that occurs before the procedure begins. In three of the studies reviewed, Gold et al. (2021), Hsu et al. (2022), and Wong & Choi (2023) identify a direct link between VR and its ability to reduce pain and anxiety for children undergoing routine procedures with needles.
- The remaining two studies by Hoag et al. (2022) and Walther-Larsen et al. (2019) did not find that VR was significantly more effective than the standard of care to reduce pain and anxiety levels. These studies still determined that VR was a successful and acceptable option for pain management and provided high levels of patient, caregiver, and provider satisfaction.
- To advance VR as a distraction technique and improve its potential for integration into standard practice, future studies must identify which modes of nonpharmacologic pain management are better suited for specific procedures and illnesses.
- For example, further research is needed to determine if VR is an appropriate choice for pain control for patients with clinically diagnosed anxiety, also known as trait anxiety. Hoag et al. (2022) touched on this topic and determined that, when compared with guided imagery, the immersive VR experience was more effective for patients with state, rather than trait, anxiety that was caused by anticipation of the procedure itself.
- Future studies must also explore whether VR is an adequate option for procedures that elicit higher levels of pain and whether it is an appropriate choice for patients with chronic pain that is more difficult to control.

Implications & The CNL Role

- The evidence, while leaning in favor of using VR as a supplemental tool for pain management, is not enough to support a complete practice alteration. The five studies reviewed did not unanimously find that VR was significantly more effective in reducing patient pain and anxiety levels.
- The findings suggest additional research is needed that focuses on higher pain-eliciting procedures and specific diagnostic groups to better determine when VR immersion would be an effective adjunctive tool to be used alongside the current standard of care.
- Additional studies around this topic should consider whether patients clinically diagnosed with anxiety will be included or excluded from the sample group.
- The quality of care for children undergoing painful routine procedures would improve overall by implementing VR as a distraction technique. Patients would have less anxiety surrounding procedures and would experience less uncontrolled pain at the hospital, resulting in higher patient and caregiver satisfaction scores (Walther-Larsen, 2019).
- The role of the CNL is to serve as a patient advocate and improve communication between interdisciplinary team members regarding patient experience. CNLs are uniquely positioned to work directly with patients while also serving as liaisons between nurses on the unit and upper management.
- When pediatric nurses on the unit recognize that patient pain and anxiety levels are not adequately managed during needle procedures, it is within the role of the CNL to facilitate effective communication between team members to ensure that continuity of care is maintained and improved patient outcomes are achieved (King et al., 2021).

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