

## Using Virtual Reality to Reduce Anxiety and Improve Hospital Experience in Paediatric Orthopaedic Patients and Their Parents

**Dr. Manish Garg;** Associate Professor, Department of Orthopaedics, Gouri Devi Institute of Medical Sciences & Hospital, Durgapur.

**Dr. Mohammad Aslam Khan;** Assistant Professor, Department of Paediatrics, N.C. Medical College & Hospital, Panipat, Haryana.

**Dr. Anand Bhushan Dixit;** Associate Professor, Department of Orthopaedics, Subharati Medical College, Meerut.

### CORRESPONDING AUTHOR:

**Dr. Anand Bhushan Dixit**

Associate Professor, Department of Orthopaedics, Subharati Medical College, Meerut.

### Abstract

**Background:** Pediatric orthopaedic care often involves extended hospital stays and can lead to heightened anxiety and distress in both patients and parents. Addressing their psychological well-being is crucial for patient satisfaction and adherence to treatment. Virtual reality (VR) has emerged as a promising tool in healthcare to alleviate anxiety and improve experiences, particularly for pediatric patients.

**Materials & Methods:** This prospective, randomized controlled trial included 200 pediatric orthopaedic patients and their parents. Participants were assigned to a VR intervention group or a control group. The VR group was provided with VR headsets and age-appropriate content for use during medical procedures. Anxiety levels (STAIC/STAI), pain perception (Wong-Baker Scale/VAS), and overall hospital experience were assessed. Statistical analysis included t-tests, chi-square tests, and regression to determine outcomes and correlations.

**Results:** The VR intervention group showed a significant reduction in anxiety levels for pediatric patients and parents, with respective mean reductions from 35.2 to 29.7 (STAIC) and 35.8 to 31.4 (STAI). Pediatric patients in the VR group reported significantly lower pain during procedures (Wong-Baker Scale) compared to the control group. Parents also reported lower pain (VAS). Moreover, the VR group expressed higher satisfaction ratings, both for pediatric patients (8.7/10) and parents (8.5/10), compared to the control group. Age, gender, and prior surgical history influenced the effectiveness of VR, with younger patients and those without previous surgeries benefiting more.

**Conclusion:** VR interventions significantly reduce anxiety, alleviate pain, and enhance the hospital experience for pediatric orthopaedic patients and their parents. These findings are consistent with previous research in the field, highlighting the broader potential of VR in healthcare. Tailoring VR interventions to demographic factors can further enhance their effectiveness. Exploring the long-term impact of VR on patients' well-being and treatment adherence remains a valuable avenue for future research.

**Keywords:** Virtual reality, pediatric orthopaedic care, anxiety reduction, pain management, hospital experience, pediatric patients, parents, demographic factors, long-term effects

### INTRODUCTION:

Pediatric orthopaedic care presents a unique challenge in healthcare, as it often requires extended hospital stays, multiple interventions, and a higher likelihood of anxiety and distress among both patients and their parents. The psychological well-being of children and their caregivers during these challenging times is a critical component of the overall healthcare experience. Anxiety and stress can significantly impact the healing process, overall satisfaction with care, and adherence to treatment regimens. Therefore, novel approaches that can alleviate anxiety and improve the hospital experience for pediatric orthopaedic patients and their parents are of utmost importance.

This research article explores the potential of virtual reality (VR) as an innovative tool to address the psychological well-being of pediatric orthopaedic patients and their parents during hospital stays. VR has gained recognition as an effective therapeutic and distraction technique for managing pain and reducing anxiety in various clinical settings, including pediatric care (Dascal *et al.*<sup>1</sup>, 2017; Gold *et al.*<sup>2</sup>, 2006; Wong *et al.*<sup>3</sup>, 2014). It offers a captivating and immersive environment that can transport users to different, soothing, and engaging worlds, diverting their attention from the anxiety-inducing hospital environment. In the context of pediatric orthopaedic care, where children often experience pain and distress, and parents grapple with the stress of seeing their children in pain, VR has the potential to be a game-changer.

This study aims to examine the impact of VR interventions on anxiety levels, pain perception, and overall hospital experience in pediatric orthopaedic patients and their parents. By creating a multidimensional evaluation that assesses the

clinical and psychological outcomes, we can provide a comprehensive understanding of the potential benefits of incorporating VR into the pediatric orthopaedic care regimen.

### **AIMS & OBJECTIVES:**

The primary aim of this research was to investigate the impact of virtual reality (VR) interventions on reducing anxiety and enhancing the hospital experience for pediatric orthopaedic patients and their parents. The specific objectives of the study included:

- **Assessing Anxiety Levels:** Anxiety levels of pediatric orthopaedic patients and their parents were measured before and after exposure to VR interventions.
- **Evaluating Pain Perception:** The effect of VR on pain perception and management in pediatric orthopaedic patients was determined, with a focus on pain reduction during medical procedures.
- **Measuring Overall Hospital Experience:** The study gauged the overall satisfaction, comfort, and perception of the hospital experience among pediatric orthopaedic patients and their parents following VR usage.
- **Comparative Analysis:** Outcomes of the VR intervention group were compared with a control group that did not receive VR treatment, evaluating differences in anxiety, pain perception, and hospital experience.
- **Exploring Potential Correlations:** The research investigated potential correlations between demographic factors, such as age, gender, and previous medical experience, and the efficacy of VR in reducing anxiety and improving the hospital experience.
- **Long-term Effects:** The study explored the lasting effects of VR intervention on the psychological well-being of pediatric orthopaedic patients and their parents, including any impact on adherence to treatment regimens and post-discharge follow-up.

### **MATERIALS & METHODS:**

#### **Participants:**

The study involved a sample size of 200 pediatric orthopaedic patients (aged 4-18 years) admitted to the orthopaedic ward of a tertiary care children's hospital and their parents. Participants were recruited following informed consent and screened for eligibility, excluding those with contraindications to VR or a history of VR-related motion sickness.

#### **Study Design:**

This was a prospective, randomized controlled trial. Participants were randomly assigned to either the VR intervention group or a control group receiving standard care.

#### **Intervention:**

The VR intervention group was provided with VR headsets and age-appropriate VR content, including immersive environments, games, and relaxation scenarios. Participants were encouraged to use the VR system during specific interventions, such as wound dressings, physiotherapy, and other painful procedures.

#### **Assessment Tools:**

Anxiety levels were assessed using validated scales like the State-Trait Anxiety Inventory for Children (STAIC) for pediatric patients and the State-Trait Anxiety Inventory (STAI) for parents.

Pain perception was measured using the Wong-Baker FACES Pain Rating Scale for pediatric patients and the Visual Analog Scale (VAS) for parents.

Overall hospital experience was evaluated through structured questionnaires and interviews.

#### **Data Collection:**

Data were collected at baseline (pre-VR exposure) and at various time points during the hospital stay. Additionally, follow-up assessments were conducted post-discharge to determine any long-term effects of VR.

#### **Statistical Analysis:**

Statistical analysis involved descriptive statistics, t-tests, chi-square tests, and regression analysis to examine the primary outcomes and explore potential correlations.

#### **Ethical Considerations:**

The study adhered to the ethical guidelines outlined by the Declaration of Helsinki and received approval from the hospital's institutional review board (IRB).

### **RESULTS**

This table provides crucial information about the study's participants at the beginning of the research. It includes the following data:

- **Age (years):** The mean age of the participants in both the VR intervention group and the control group is very similar, with the VR group having a mean age of 10.2 years and the control group 10.1 years. This indicates that the randomization process was effective in creating groups with comparable ages.
- **Gender (M/F):** The distribution of gender in both groups is quite balanced, with a slight majority of males in both groups (54% in the VR group and 52% in the control group).
- **Previous Surgery:** A history of previous surgery is noted for 34% of the participants in the VR group and 37% in the control group, indicating that this characteristic is relatively balanced between the two groups.
- **Anxiety Levels (STAIC/STAI):** The baseline anxiety levels, as measured by STAIC for pediatric patients and STAI for parents, are quite similar between the two groups. The mean anxiety levels are 35.2 for pediatric patients in the VR group and 35.8 for parents, while the control group shows similar figures. This suggests that the two groups were well-matched in terms of anxiety levels at the outset of the study.

**Table 1: Baseline Characteristics of Study Participants**

Characteristic	VR Intervention Group (n=100)	Control Group (n=100)
Age (years)	Mean ± SD: 10.2 ± 2.1	Mean ± SD: 10.1 ± 2.2
Gender (M/F)	54/46	52/48
Previous Surgery	34 (34%)	37 (37%)
Anxiety Levels (STAIC/STAI)	Mean ± SD: 35.2 ± 6.4 (pediatric patients)	Mean ± SD: 35.8 ± 6.1 (parents)

Table 2 illustrates the changes in anxiety levels for pediatric patients and their parents before and after exposure to VR. Here's what the data reveals:

- **Pediatric Patient Anxiety Levels (STAIC):** Before VR exposure, the mean anxiety level for pediatric patients in the VR group was 35.2, which reduced significantly to 29.7 after VR exposure. In contrast, the control group showed a minor change in anxiety levels from 36.1 to 36.3 during the same time frame.
- **Parent Anxiety Levels (STAI):** The baseline anxiety levels for parents in the VR group were 35.8, and this decreased to 31.4 post-VR exposure. In the control group, there was only a slight change from 36.0 to 36.2. These figures suggest that VR had a notable impact in reducing anxiety for both pediatric patients and their parents.

**Table 2: Changes in Anxiety Levels Pre and Post VR Exposure**

Outcome Measure	VR Intervention Group (n=100)	Control Group (n=100)
Pediatric Patient Anxiety Levels (STAIC)	Pre-VR: 35.2 ± 6.4	Pre-Procedure: 36.1 ± 6.3
	Post-VR: 29.7 ± 5.3	Post-Procedure: 36.3 ± 6.5
Parent Anxiety Levels (STAI)	Pre-VR: 35.8 ± 6.1	Pre-Procedure: 36.0 ± 6.2
	Post-VR: 31.4 ± 5.9	Post-Procedure: 36.2 ± 6.4

This table-3 emphasizes the perception of pain during medical procedures in the VR intervention group compared to the control group:

- **Pediatric Patient Pain (Wong-Baker Scale):** The data shows that pediatric patients in the VR group reported significantly lower pain levels during procedures, with a mean score of 4.2, while the control group reported a higher mean score of 5.1.
- **Parental Pain (VAS):** Similarly, parents in the VR group also reported lower pain levels during procedures, with a mean score of 4.3, compared to the control group's mean score of 5.0. These figures demonstrate that VR was effective in reducing perceived pain during medical procedures

**Table 3: Pain Perception During Medical Procedures**

Outcome Measure	VR Intervention Group (n=100)	Control Group (n=100)
Pediatric Patient Pain (Wong-Baker Scale)	During Procedure: 4.2 ± 1.3	During Procedure: 5.1 ± 1.2
Parental Pain (VAS)	During Procedure: 4.3 ± 1.2	During Procedure: 5.0 ± 1.3

This table-4 presents participant satisfaction ratings, offering insights into their overall hospital experience:

- **Pediatric Patient Satisfaction (1-10):** In the VR group, pediatric patients rated their satisfaction with a mean score of 8.7 out of 10, indicating a high level of satisfaction. In contrast, the control group rated their satisfaction slightly lower, with a mean score of 7.9.

- **Parental Satisfaction (1-10):** The data for parental satisfaction mirrors the pediatric patients' results, with the VR group reporting a higher mean satisfaction rating of 8.5, while the control group's rating was slightly lower, at 7.8. These figures underscore that VR not only reduces anxiety and pain but also enhances the overall hospital experience, resulting in higher satisfaction ratings.

**Table 4: Overall Hospital Experience Ratings**

Outcome Measure	VR Intervention Group (n=100)	Control Group (n=100)
<b>Pediatric Patient Satisfaction (1-10)</b>	8.7 ± 1.2	7.9 ± 1.4
<b>Parental Satisfaction (1-10)</b>	8.5 ± 1.3	7.8 ± 1.5

Table 5 conducts a comparative analysis of the VR intervention group and the control group, demonstrating the effects of VR on various parameters:

- **Pediatric Patient Anxiety Levels (STAIC):** The p-value (0.001) indicates a highly significant difference between the pre- and post-procedure anxiety levels for the VR group. In contrast, the control group showed no significant difference. This suggests that VR significantly reduced anxiety levels in pediatric patients.
- **Parent Anxiety Levels (STAI):** Similarly, the p-value (0.002) demonstrates a significant reduction in parental anxiety levels in the VR group post-procedure, while the control group experienced no significant change.
- **Pediatric Patient Pain (Wong-Baker Scale):** The p-value (0.004) shows a significant reduction in pain levels during procedures for the VR group, whereas the control group did not experience such a significant change.
- **Parental Pain (VAS):** The p-value (0.005) reveals that parental pain levels were significantly reduced during procedures in the VR group compared to the control group.
- **Pediatric Patient Satisfaction (1-10):** The p-value (0.001) shows that the VR group reported significantly higher satisfaction ratings compared to the control group.
- **Parental Satisfaction (1-10):** Similarly, the p-value (0.002) indicates that parents in the VR group reported significantly higher satisfaction ratings than those in the control group. These p-values confirm the statistical significance of the benefits of VR in reducing anxiety, managing pain, and enhancing the hospital experience.

**Table 5: Comparative Analysis**

Outcome Measure	VR Intervention Group (n=100)	Control Group (n=100)	p-value
<b>Pediatric Patient Anxiety Levels (STAIC)</b>	Pre-Procedure vs. Post-Procedure	Pre-Procedure vs. Post-Procedure	0.001
<b>Parent Anxiety Levels (STAI)</b>	Pre-Procedure vs. Post-Procedure	Pre-Procedure vs. Post-Procedure	0.002
<b>Pediatric Patient Pain (Wong-Baker Scale)</b>	During Procedure	During Procedure	0.004
<b>Parental Pain (VAS)</b>	During Procedure	During Procedure	0.005
<b>Pediatric Patient Satisfaction (1-10)</b>	During Procedure	During Procedure	0.001
<b>Parental Satisfaction (1-10)</b>	During Procedure	During Procedure	0.002

Table 6 explores how demographic factors relate to the effectiveness of VR in reducing anxiety. Here's what the data reveals:

- **Age:** There is a negative correlation (-0.12) between age and the effectiveness of VR in reducing anxiety, indicating that younger patients may experience more significant reductions in anxiety when using VR.
- **Gender (M/F):** The correlation (0.07) between gender and VR efficacy suggests that the effectiveness of VR is relatively consistent between male and female patients.
- **Previous Surgery:** A negative correlation (-0.19) between a history of previous surgeries and VR efficacy suggests that patients with prior surgical experiences may benefit less from VR interventions. These correlations provide valuable insights into the individual factors that can influence the efficacy of VR in managing anxiety.

**Table 6: Correlations Between Demographic Factors and VR Efficacy**

Demographic Factor	Correlation with VR Efficacy (Anxiety Reduction)	p-value
<b>Age</b>	-0.12	0.045
<b>Gender (M/F)</b>	0.07	0.132

Demographic Factor	Correlation with VR Efficacy (Anxiety Reduction)	p-value
Previous Surgery	-0.19	0.019

## DISCUSSION

This study investigates the innovative use of virtual reality (VR) to alleviate anxiety and enhance the hospital experience for pediatric orthopaedic patients and their parents. The findings suggest that VR interventions hold significant promise in pediatric orthopaedic care, as they result in various positive outcomes. This discussion explored the implications of these results while comparing them to prior research.

One of the key objectives of this study was to evaluate the impact of VR on anxiety levels in both pediatric patients and their parents. The findings reveal a substantial reduction in anxiety levels following exposure to VR. Pediatric patients who used VR reported a remarkable decrease in anxiety, as evidenced by the significant reduction in STAIC scores. This aligns with previous research by Dascal *et al*<sup>1</sup>. (2017), Gold *et al*<sup>2</sup>. (2006), and Riva *et al*<sup>4</sup>. (2016), which demonstrated that VR can effectively reduce anxiety in clinical settings.

Furthermore, the study demonstrated a statistically significant decrease in parental anxiety levels (STAI) after VR exposure. This aligns with the findings of Wong *et al*<sup>3</sup>. (2014) and Schneider *et al*<sup>5</sup>. (2020), which showed that VR interventions can have a positive impact on anxiety levels in parents of pediatric patients. The reduction in parental anxiety is crucial as it can create a more supportive and less stressful environment for the child, contributing to improved overall well-being.

Another significant outcome of the study is the positive impact of VR on pain perception and management during medical procedures. Pediatric patients in the VR group reported significantly lower pain levels, as indicated by the Wong-Baker Scale. This finding is consistent with previous studies that have shown the effectiveness of VR in managing pain during medical procedures (Gold *et al*<sup>2</sup>., 2006; Maani *et al*<sup>6</sup>., 2011; Nilsson *et al*<sup>7</sup>., 2019).

Moreover, parents in the VR group reported lower pain levels during procedures, emphasizing the potential of VR to ease the distress experienced by both patients and their caregivers. This aligns with the work of Hoffman *et al*<sup>8</sup>. (2000), Windich *et al*<sup>9</sup>. (2013), and Schmitt *et al*<sup>10</sup>. (2019), which demonstrated that VR can be a valuable tool in improving pain management and reducing distress during medical interventions.

The data also indicates that the use of VR in pediatric orthopaedic care significantly enhances the overall hospital experience. Pediatric patients and parents in the VR group reported higher satisfaction ratings compared to the control group. These findings support the notion that VR can not only reduce anxiety and pain but also contribute to a more positive and comfortable hospital experience.

Comparative analysis reveals that the benefits of VR in reducing anxiety, managing pain, and enhancing the hospital experience are statistically significant. This is in line with the research conducted by Indovina *et al*<sup>11</sup>. (2018) and Mahrer *et al*<sup>12</sup>.(2018) which emphasized the importance of VR in improving the overall hospital experience for pediatric patients.

The study further explored potential correlations between demographic factors and the effectiveness of VR. Age was found to have a negative correlation with the efficacy of VR in reducing anxiety, suggesting that younger patients may benefit more from VR interventions. This is consistent with the work of Mahrer *et al*<sup>12</sup>. (2018), who reported that younger children tend to be more engaged with VR experiences and, as a result, may experience greater anxiety reduction.

The correlation analysis also showed that a history of previous surgeries had a negative correlation with the effectiveness of VR. This implies that patients with prior surgical experiences may benefit less from VR interventions. While this result was not directly supported by previous literature, it suggests the need for tailored interventions for patients with differing medical histories.

Lastly, the study aimed to explore the long-term effects of VR interventions. These findings are especially important for understanding the lasting impact of VR on the psychological well-being of pediatric orthopaedic patients and their parents. It is hypothesized that the reduction in anxiety and pain perception during the hospital stay could lead to improved adherence to treatment regimens and better post-discharge follow-up.

## CONCLUSION

In conclusion, this study demonstrates that VR interventions have the potential to significantly reduce anxiety, alleviate pain, and enhance the hospital experience for pediatric orthopaedic patients and their parents. The findings align with

previous research in the field of VR interventions in healthcare settings. The implications of this research extend beyond anxiety reduction and pain management, as they encompass the broader context of improving overall well-being during hospital stays. The study emphasizes the importance of considering individual demographic factors when implementing VR interventions and opens up avenues for further exploration of the long-term impact of such interventions on pediatric orthopaedic care.

#### REFERENCES:

1. Dascal, J., Reid, M., IsHak, W. W., Spiegel, B., Recacho, J., Rosen, B., & Danovitch, I. (2017). Virtual reality and medical inpatients: A systematic review of randomized, controlled trials. *Innovations in Clinical Neuroscience*, 14(1-2), 14-21.
2. Gold, J. I., Kim, S. H., Kant, A. J., Joseph, M. H., & Rizzo, A. S. (2006). Effectiveness of virtual reality for pediatric pain distraction during i.v. placement. *CyberPsychology & Behavior*, 9(2), 207-212.
3. Wong, C. L., Lui, M. M., Choi, K. C., Tsui, K. W., & So, R. C. (2014). A virtual reality app for pain management of pediatric acute burn injuries: a randomized controlled trial. *Annals of Plastic Surgery*, 73(3), 276-282.
4. Riva, G., Wiederhold, B. K., & Mantovani, F. (2016). Neuroscience of virtual reality: From virtual exposure to embodied medicine. *Cyberpsychology, Behavior, and Social Networking*, 19(3), 172-173.
5. Schneider, S. M., Ellis, M., Coombs, D., Shonk, D., & Folsom, L. C. (2020). Promoting engagement in self-management using patient-generated virtual reality and gamification. *Computers in Human Behavior*, 104, 106160.
6. Maani, C. V., Hoffman, H. G., Fowler, M., Maiers, A. J., Gaylord, K. M., Desocio, P. A., ... & Patterson, D. R. (2011). Combining ketamine and virtual reality pain control during severe burn wound care: one military and one civilian patient. *Pain Medicine*, 12(4), 673-678.
7. Nilsson, S., Finnström, B., Kokinsky, E., Enskär, K., Jonsson, R., & Berg, M. (2019). The use of virtual reality for needle-related procedural pain and distress in children and adolescents in a paediatric oncology unit. *European Journal of Cancer Care*, 28(1), e12886.
8. Hoffman, H. G., Doctor, J. N., Patterson, D. R., Carrougher, G. J., & Furness, T. A. (2000). Virtual reality as an adjunctive pain control during burn wound care in adolescent patients. *Pain*, 85(3), 305-309.
9. Windich, M., Morris, A., and Mann, N. (2013). The effectiveness of virtual reality for dental pain control: A case study. *Australian Dental Journal*, 58(1), 103-107.
10. Schmitt, Y. S., Hoffman, H. G., Blough, D. K., Patterson, D. R., Jensen, M. P., Soltani, M., & Sharar, S. R. (2019). A randomized, controlled trial of immersive virtual reality analgesia during physical therapy for pediatric burns. *Burns*, 45(6), 1236-124.
11. Indovina, P., Barone, D., Gallo, L., Chirico, A., De Pietro, G., & Antonio, A. (2018). Virtual reality as a distraction intervention to relieve pain and distress during medical procedures: A comprehensive literature review. *The Clinical Journal of Pain*, 34(9), 858-877.
12. Mahrer, N. E., Gold, J. I., Luu, M., Lewis, L., Trujillo, D., & McBride, C. (2018). A randomized controlled trial of virtual reality for pain management in children with acute burn injuries. *The Journal of Behavior Therapy and Experimental Psychiatry*, 61, 165-172.