



# The Effect of Virtual Reality on Pain Scores During Knee Extension Torque Testing Following Anterior Cruciate Ligament Reconstruction

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## BACKGROUND

- Anterior Cruciate Ligament (ACL) injuries are common and carry a heavy burden of time loss.<sup>1,2</sup> ACL Reconstructions (ACLR) are associated with a host of physical and psychological impairments, and these impairments can persist well beyond the time frame of return to sport.<sup>3</sup>
- Recent literature has investigated the role of neuroplastic changes following ACLR. Virtual Reality (VR) has been proposed as one modality that may target associated deficits.<sup>4,5</sup>
- VR has been shown to have positive effects on both acute and chronic pain through influences on attention and emotion.<sup>6,7,8</sup> It may be a useful tool to address pain during rehabilitation while improving early impairments.

## OBJECTIVES

1. Investigate the effect of a relevant VR task on pain during knee extension torque testing following ACLR.
2. This study was a secondary analysis performed in addition to investigating the role of VR on knee extension torque.

## METHODS

- Patients undergoing ACLR and performing rehabilitation at Samaritan Athletic Medicine were recruited via sample of convenience. Patients were excluded if they had a devastating lower limb injury, osteochondral defect >1cm<sup>2</sup>, or a previously diagnosed neurological condition.
- Participants split into two groups for within-subject crossover design:
  - Group A = VR condition on Day 1
  - Group B = VR condition on Day 2
- Underwent knee extension torque testing utilizing a handheld dynamometer on Post-Op week 7 on two non-consecutive days, under one of two conditions:
  - VR Condition
    - 5 sets of 3 maximal repetitions
    - Each repetition coinciding with a VR Leg press repetition
  - No-VR Condition
    - 5 sets of 3 maximal repetitions
    - Standardized rest periods to match VR condition
- Pain scores were collected at each repetition utilizing the Numeric Pain Rating Scale (NPRS).
- A related-samples Wilcoxon Signed Rank test was performed to determine the association between pain and the presence of the VR condition.

## RESULTS

- **Subjects were young and highly active**
  - Twenty participants, 10 females and 10 males with a mean age (SD) of 23.61 ( $\pm 7.4$ ) years performed testing under both conditions.
  - The mean Tegner Activity Scale (TAS) of participants was 7.9, indicating participation in competitive sport.
- **There was no significant difference in pain between conditions**
  - Mean pain scores (SE) during testing were 2.73 ( $\pm 45$ ) and 2.79 ( $\pm 44$ ) for VR and No-VR conditions, respectively.
  - The related-samples Wilcoxon Signed Rank Test showed no significant difference ( $p=.615$ ) in pain between VR and No-VR testing.
  - There was a small effect size,  $r=.11$ , on pain when individuals were performing the task under VR conditions.

Figure 1. Comparison of Average Pain Scores Between VR and No VR Conditions

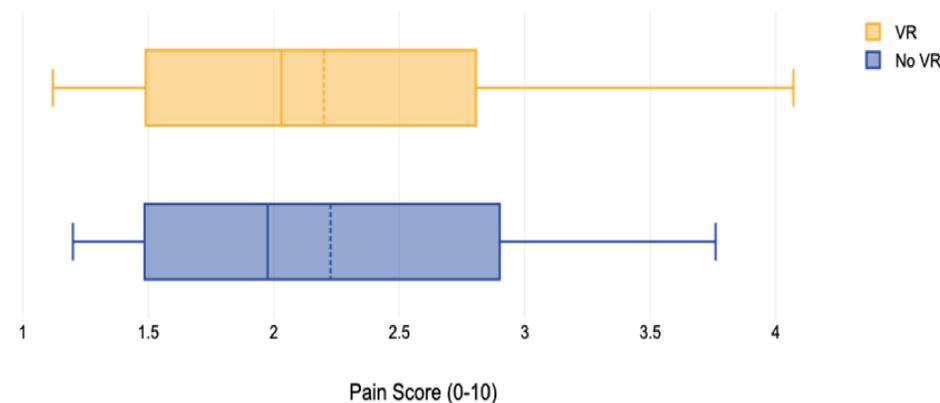


Figure 2: Virtual Reality Leg Press Task



## DISCUSSION

- For those seven weeks post ACLR, there was no significant difference in pain scores during knee extension torque testing when utilizing VR or No-VR.
- Previous research regarding the effect of VR on pain has explored fully or partially immersive virtual environments; our task was non-immersive in nature.<sup>6,8</sup>
- The VR task may have lacked the saliency present in previous studies utilizing more activity-specific environments and visual-spatial information.<sup>5</sup>
- While the analgesic effects of VR have been proposed to originate due to distraction, collecting pain scores after every repetition may have reduced this effect on attention.<sup>6,7,8</sup>

## FUTURE IMPLICATIONS

- Future research may direct efforts towards investigating the role of more immersive virtual reality environments on pain during ACLR rehabilitation. More immersive and interactive environments may maximize the distractive effects of virtual reality.

## REFERENCES & ACKNOWLEDGEMENTS

- We would like to thank Olivia Pipitone, MPH and the Research Development Office at Samaritan Health for their contributions and assistance throughout the study.

