Imperial College London

Who learns best: The tortoise or the hare? A randomised controlled trial of spaced practice versus intense training in immersive virtual reality

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Introduction

- Hands-on operating experience for current trainees is decreasing, which has been exacerbated by the recent pandemic
- Immersive virtual reality (iVR) has been shown to improve trainee performance in both complex open and endoscopic procedures, however optimal delivery of this training is unknown
- Evidence suggests training with a one week consolidation period between sessions (spaced practice), may have some advantages over intense daily training for learning surgical skills
- However, evidence in this area for complete operations is currently lacking
- Anterior Approach Total Hip Arthroplasty (AA-THA), is a difficult operation with a prolonged learning curve and therefore an excellent vehicle to test learning
- **Aims:** To establish whether there are any differences in skill acquisition and retention comparing intense daily learning and spaced practice (weekly learning) in AA-THA iVR simulation?

Methods

- 24 medical students were randomised to learning AA-THA in iVR, either once daily for 4 days (intense training) or once weekly for 4 weeks (spaced practice)
- Baseline characteristics were recorded (Table 1) and baseline knowledge and skills were assessed using a written assessment and saw bone assessment orientating an acetabular component to a target of 40° inclination, 20° anteversion (Fig 1)
- In each iVR session students underwent a guided mode followed by an unguided assessment.
- Following the 4th session, the unguided iVR and real world saw bone assessments were repeated at 1 week and 1 month
- Primary outcome: Procedural errors in iVR
- Secondary outcomes: Time, prompts, real world acetabular component orientation error

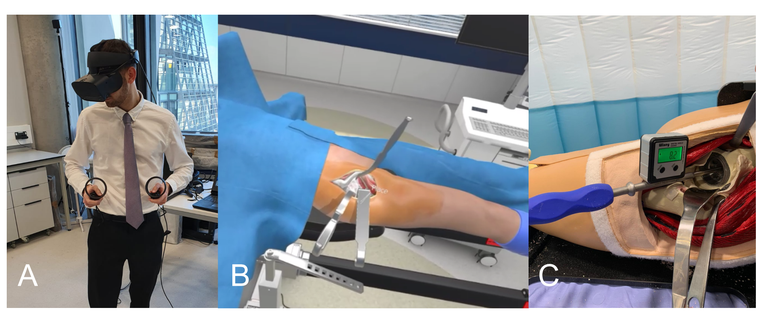

Figure 1: A) The iVR set up B) The participants view in the iVR module C) Measuring the anteversion in the saw bone real world assessment using a digital goniometer

Characteristic	Daily Group (n=12)	Weekly Group (n=12)	p-value
Male:female (n)	6:6	7:5	0.682
Mean age (years)	21	21.42	0.532
Right:left handedness (n)	11:1	11:1	>0.999
Mean video-game experience (hours per week)	4.13	3.17	0.7004

Table 1. Baseline characteristics

Results

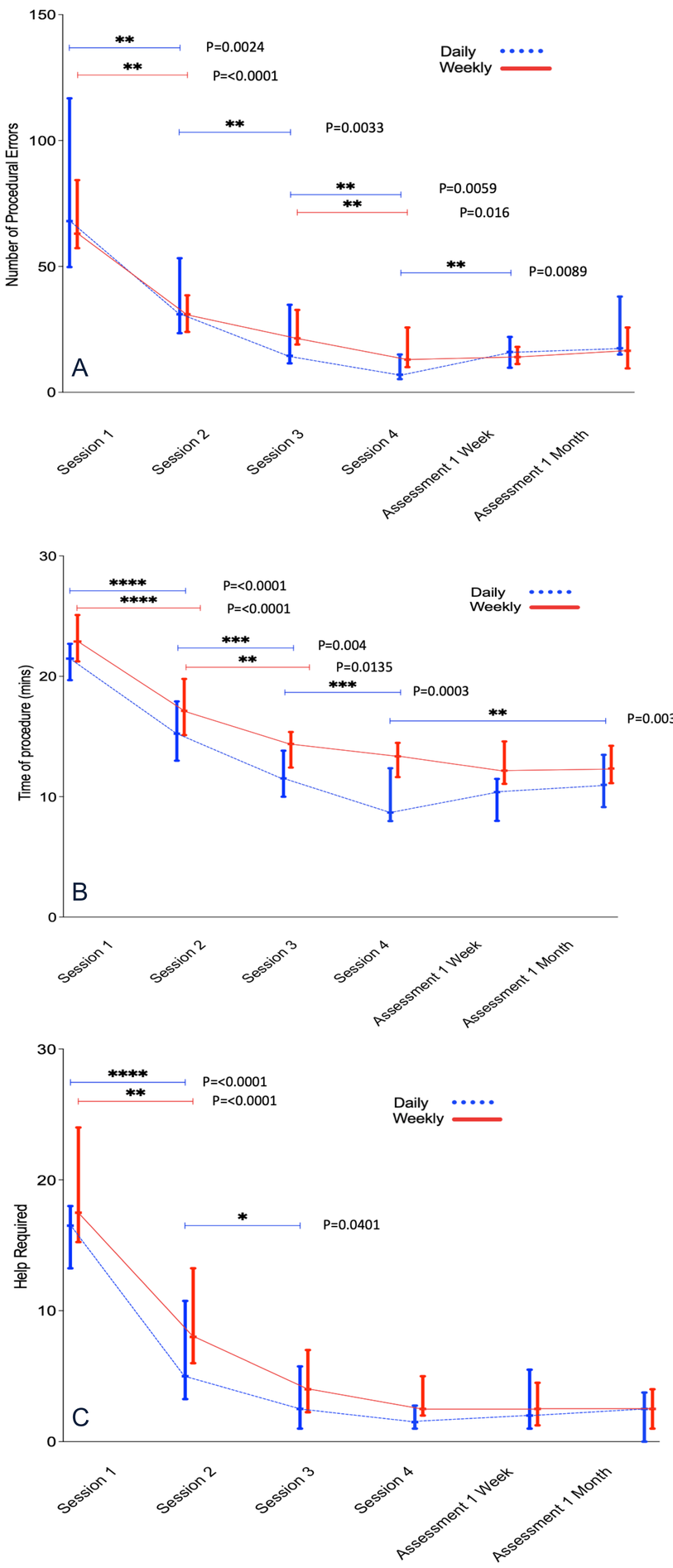

Figure 2: Learning and forgetting curves for outcomes (A: Procedural errors, B: Time, C: Number of assistive prompts) from the iVR assessments at all six time points. Median and IQR depicted with daily group in blue and weekly group in red. Significant differences (p<0.05) between sessions demonstrated with an asterisk (*)

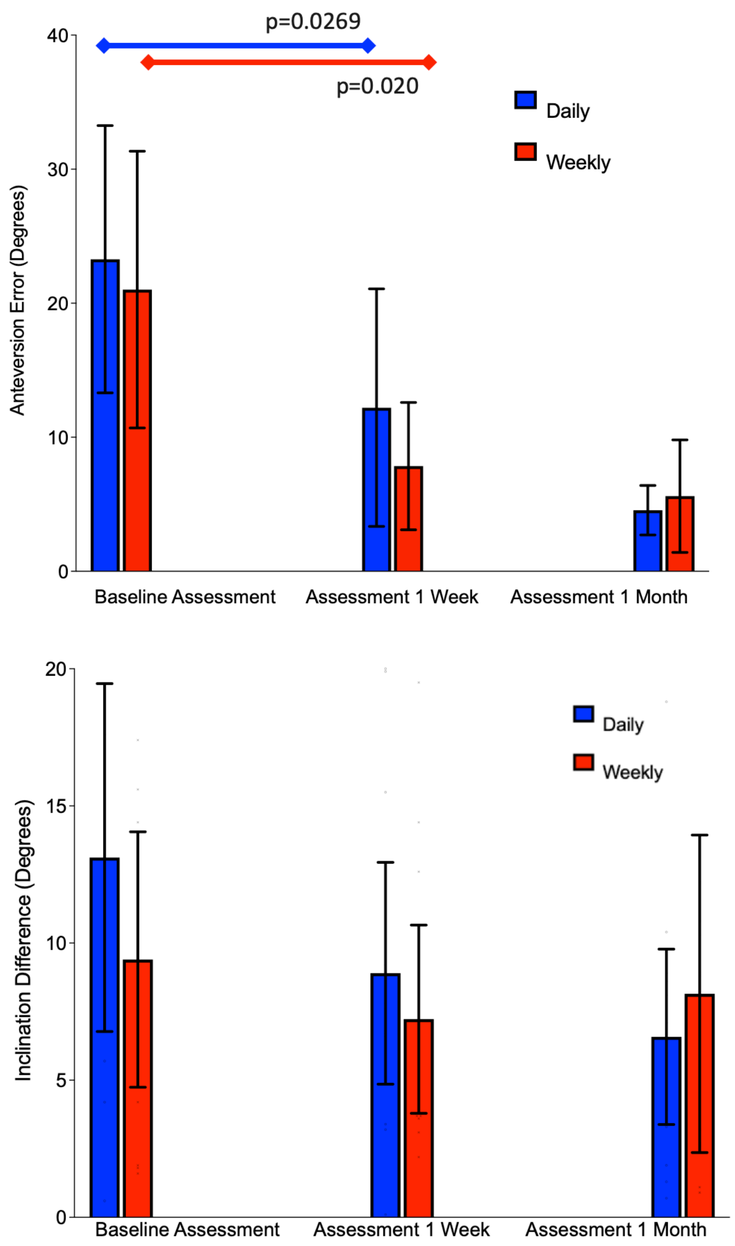

Figure 3: Bar charts depicting mean error in ° from a target of 40° inclination and 20° anteversion in the physical world saw bone assessments at baseline and two follow up points. Top image shows anteversion and the bottom image inclination error. Error bars demonstrate a 95% confidence interval. Significant p-values (p <0.05) indicated

Conclusion

- Spaced practice learning led to a slower acquisition but greater retention of procedural skills when compared to the intense learning group
- Visuospatial skills learnt in iVR translate to the physical world and are retained at 1 month in both groups
- Clinical application: VR technology is becoming more accessible. This data can be used in designing VR/simulation curricula to augment training in the future