A randomised study comparing 2D 4K vs 3D 4K imaging systems in a pelvitrainer model

Tibor Andrea Zwimpfer[1,2], Claudine Wismer[3], Andreas Schötzau[1], Bernhard Fellmann-Fischer[1], Viola Heinzelmann-Schwarz[1,2]

[1] University Hospital of Basel, Department of Obstetrics and Gynaecology, [2] Department of Biomedicine, University Basel, [3] University Basel, Medical Faculty

Background

Laparoscopic surgery provides well-known benefits for the patient, but imitations remain regarding its technology. Depth perception is particularly crucial to this medical procedure, with three-dimensional (3D) imaging being superior to two-dimensional (2D) HD imaging due to its improved image quality and ability to gauge space. However, with the introduction of 4K resolution monitors, 2D rendering is now capable of providing surgeons with higher quality visuals and may offer a competitive alternative to current 3D technology. As such, this study aims to compare 3D 4K and 2D 4K imaging using a pelvitrainer model.

Methods

40 subjects were divided into two categories based on different experience levels (8 experts and 32 medical students). A Williams Design was used for the randomisation of the subjects, with each participant performing the same four standardised tasks with the 2D 4K and 3D 4K imaging systems. Task completion time and the number of errors made in each task were recorded. For statistical analysis the Wilcoxon-Test and mixed effects model were applied. After completing the tasks, participants answered questions concerning the two systems.

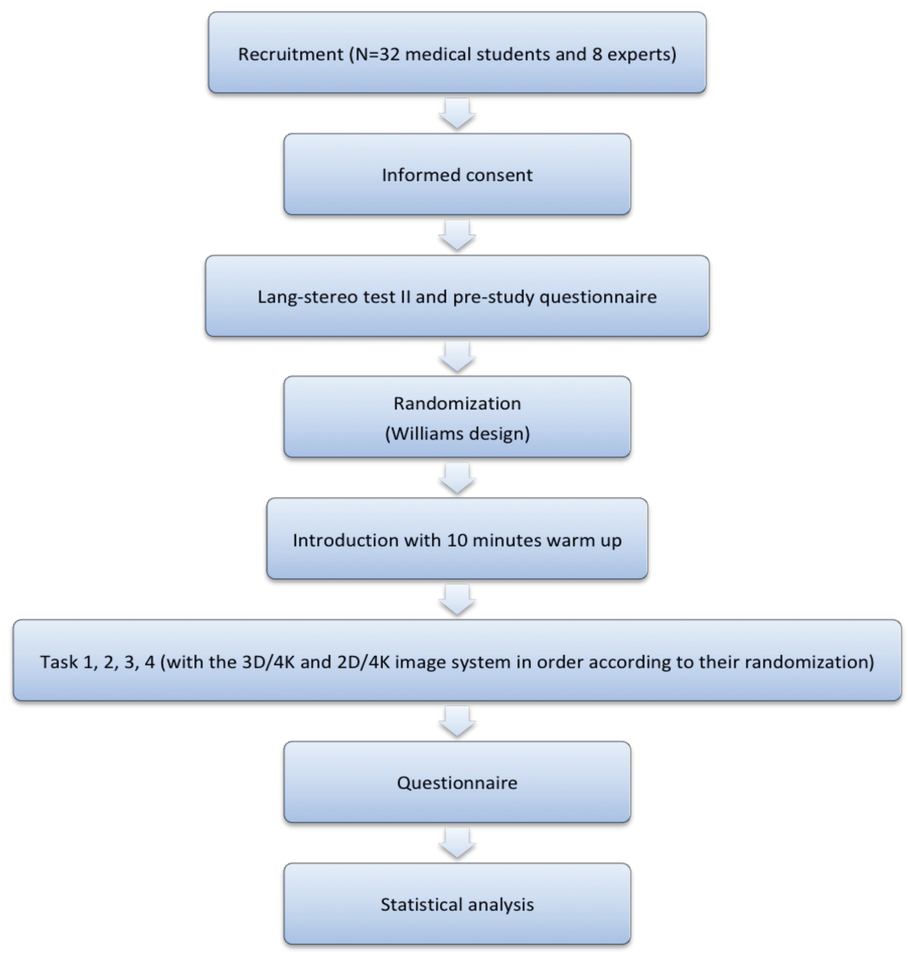

Figure 1 Consort diagram

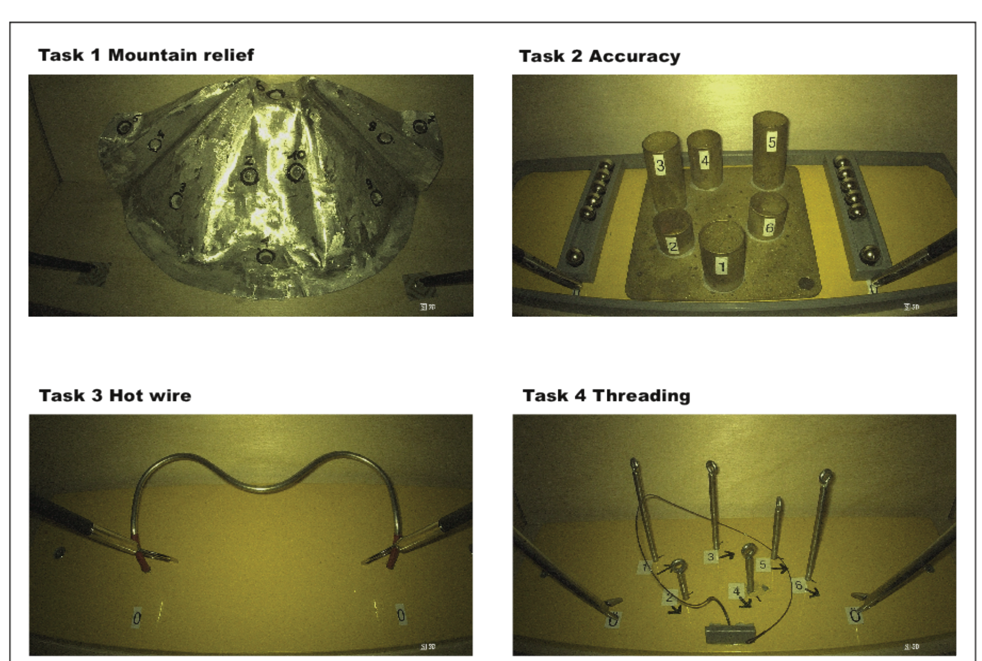

Figure 2 Illustration of the start position of tasks 1 – 4 with the 3D 4K image system as explained in the methods section.

Results

The 3D 4K system enabled the students to have better accuracy targeting points and movements and students were therefore significantly faster in all four tasks with the 3D 4K perspective. The median difference ranged from 18 seconds in task 3 (P<0.003) up to 177.5 seconds in task 4 (P<0.001). With the exception of task 4, students demonstrated significantly fewer errors in all tasks involving 3D 4K imaging, with the highest median difference of 34.5 in task 3 (P<0.001). The experts results confirm the results given by the students being faster in all four tasks with 3D 4K, significantly in task 1 (P<0.001) and task 4 (P<0.006). The experts group also obtained better accuracy of movement using the 3D 4K system, with fewer mistakes in all four tasks, significantly in task 4 (P<0.001). The questionnaire revealed the subjective feeling to be better with the 3D 4K system correlating with the faster completion of the tasks. 35% reported the goggles as distracting. One participant experienced nausea using the 3D system.

Conclusion

This study showed that most of the participants in both groups achieved better results with the 3D 4K image system than with the 2D 4K system. Not only was the amount of errors significantly lower using the 3D 4K system, but the duration of each task was also significantly shorter. Therefore this study encourages the use of 3D 4K image systems when available in the hospital.

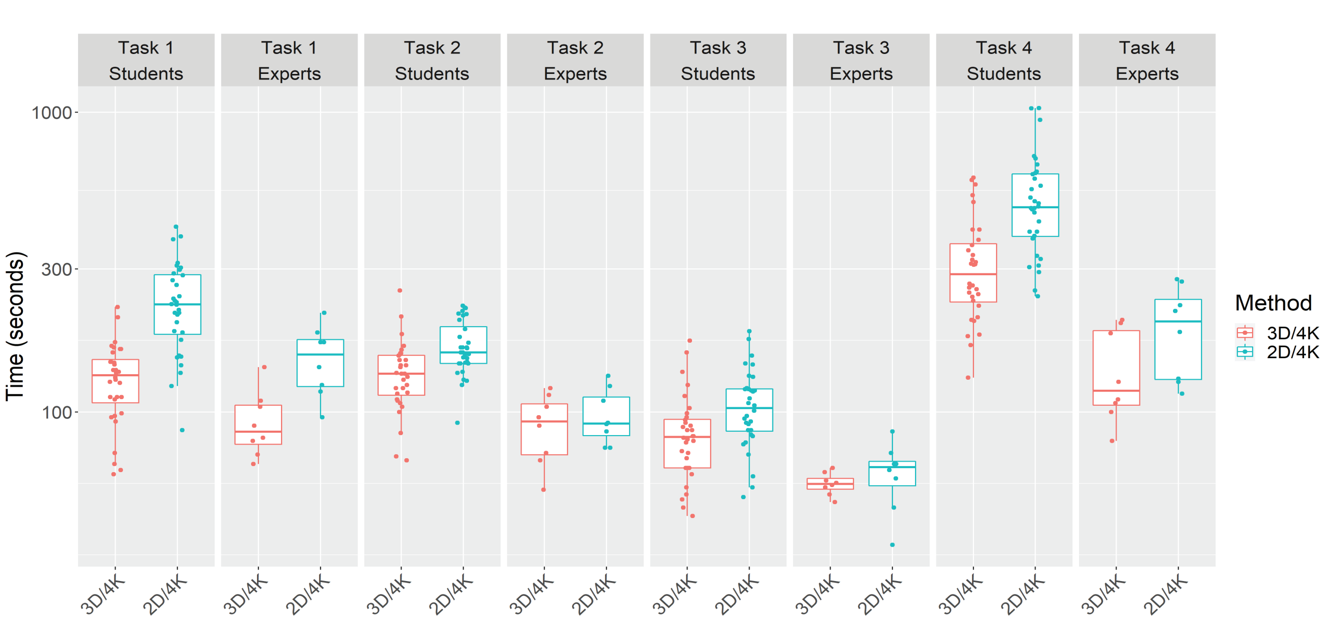

Figure 3 The figure presents the comparison of the 3D 4K and 2D 4K image system in terms of needed time (seconds) for both experience groups.

Status	contrast	task	Geometric mean ratio	95% Confidence Interval lower	95% Confidence Interval upper	p.value
students	3D/4K - 2D/4K	1	0.5622	0.4859	0.6504	<0.001
students	3D/4K - 2D/4K	2	0.8027	0.6939	0.9287	0.0033
students	3D/4K - 2D/4K	3	0.802	0.6932	0.9278	0.0032
students	3D/4K - 2D/4K	4	0.6053	0.5232	0.7002	<0.001
experts	3D/4K - 2D/4K	1	0.6144	0.485	0.7783	<0.001
experts	3D/4K - 2D/4K	2	0.9091	0.7177	1.152	0.4218
experts	3D/4K - 2D/4K	3	0.9446	0.7457	1.197	0.6303
experts	3D/4K - 2D/4K	4	0.7146	0.5641	0.9052	0.0063

Table 1 The table shows the p-values of the automatically measured mistakes in contrast of the 3D/4K image system for every task and both experience groups. The p-value was calculated with the parametric mixed-effects model where we specified the mean ratio which approximately accords to the median. A p-value < 0.05 was considered as significant.

Contact: tibor.zwimpfer@unibas.ch