Concurrent Validity Testing of a Virtual Reality Robotic Surgical Simulator

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Background:

Virtual reality simulators are often utilized for surgical skills training. In order to be considered useful for assessment purposes, rigorous criterion validity testing is required.

Purpose:

We conduct concurrent validity testing of a commercially available robotic surgical simulator; dV-Trainer™ (dVT).

Methods:

Urology residents, fellows, and attending surgeons were enrolled in this IRB-approved study. Subjects first completed 3 repetitions of 4 different tasks (PB, MB, NT, RR) on the dVT. One week later, subjects completed 4 similar tasks using the da Vinci® robot (dVR). For each exercise, participants were assessed on total task time as well as total errors using the built-in scoring algorithm or manual scoring for the dVT and dVR, respectively.

Results:

13 novice (NRS) and 7 experienced robotic surgeons (ERS) were included in the study; ERS defined by >50hours of robotic console time. ERS outperformed NRS in many of the dVT and dVR exercises, particularly with respect to number of errors (see table). On pooled data analysis, both dVT total task time and total errors correlated with dVR total task time ($p=0.026$) and total errors ($p=0.011$), respectively.

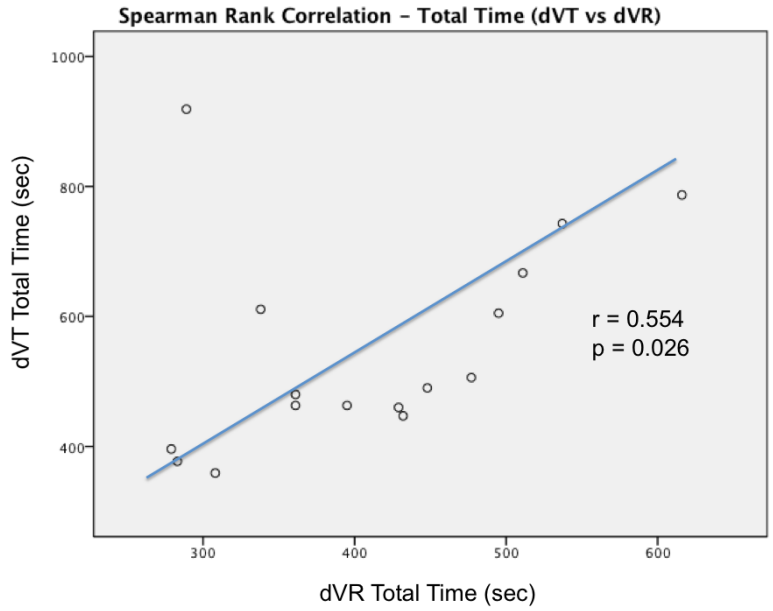
Conclusions:

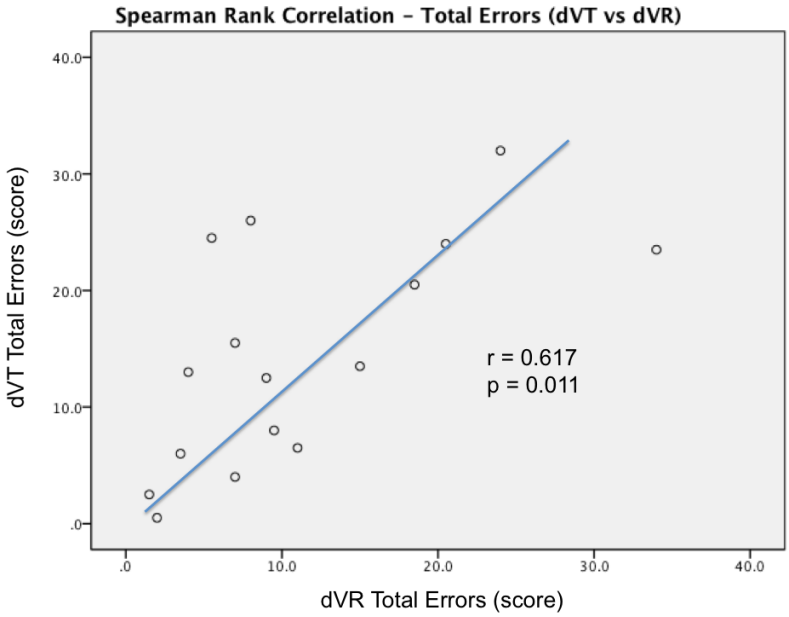
This study demonstrates that in addition to face, content, and construct validity, the dV-Trainer™ also has concurrent validity.

TABLE 1 – Experienced vs Novice Robotic Surgeon Performance

	Novice (mean ± SD)	Experienced (mean ± SD)	p-value
dV-Trainer™			
PB time	90.9 ± 27.7	79.6 ± 9.8	0.320
PB errors	2.6 ± 2.2	1.0 ± 1.2	**0.049**
MB time	248.1 ± 101.4	218.4 ± 79.3	0.510
MB errors	4.3 ± 3.7	1.3 ± 1.5	**0.019**
NT time	188.5 ± 49.9	144.7 ± 28.1	**0.022**
NT errors	8.4 ± 3.9	2.5 ± 2.0	**0.002**
RR time	49.1 ± 13.9	46.7 ± 10.1	0.698
RR errors	2.0 ± 1.8	0.9 ± 0.9	0.077
TOTAL time	576.5 ± 163.2	489.4 ± 110.4	0.225
TOTAL errors	17.2 ± 8.57	5.6 ± 4.1	**0.001**
dV Robot			
PB time	67.4 ± 20.1	69.0 ± 26.9	0.907
PB errors	2.5 ± 1.9	0.5 ± 0.5	**0.005**
MB time	135.5 ± 46.8	102.3 ± 53.4	0.297
MB errors	2.6 ± 1.9	0.2 ± 0.2	**0.001**
NT time	179.5 ± 39.8	142.0 ± 26.1	0.147
NT errors	5.5 ± 3.5	1.7 ± 0.8	**0.003**
RR time	42.2 ± 9.6	33.0 ± 7.6	0.145
RR errors	2.7 ± 2.5	0 ± 0	**0.002**
TOTAL time	424.6 ± 96.1	346.3 ± 113.2	0.236
TOTAL errors	13.3 ± 8.7	2.3 ± 1.0	**0.001**

PB = Pegboard, MB = Matchboard, NT =Needle Threading, RR = Ring and Rail


Spearman Rank Correlation – Total Time (dVT vs dVR)
dVT Total Time (sec)
1000
800
600
400
300
400
500
600
dVR Total Time (sec)
r = 0.554
p = 0.026


Spearman Rank Correlation – Total Errors (dVT vs dVR)
dVT Total Errors (score)
40.0
30.0
20.0
10.0
.0
.0
10.0
20.0
30.0
40.0
dVR Total Errors (score)
r = 0.617
p = 0.011