

AN ALTERNATIVE TO HAPTICS IN ROBOTIC SURGERY

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The purpose of this study was to examine the effect of visually perceived force information as an alternative to haptics in simulated robotic surgery. It was hypothesized that providing an analog for force feedback through the visual channel could benefit performance in the absence of actual force feedback. A controlled experiment with six subjects was conducted, using a 2x2 within-subject repeated measures design, to examine performance in a simple line-drawing task in a simulator box using a conventional laparoscopic grasper with inherent force feedback and a robotic manipulator with no force feedback. The task was performed on a hard surface and a soft surface. Physical deformation on the soft surface provided additional visual cues regarding the forces applied during the task. Results showed significant main effects in type of surface ($F=6.10$, $df=1$, $p=0.015$) and type of tool used ($F=37.02$, $df=1$, $p<0.001$) for task completion time. There was no interaction between the two independent variables. In terms of the number of errors made during the trials, there was a significant tool effect only ($F=12.03$, $df=1$, $p<0.001$). In the absence of force feedback, performance was better when the visual analog of force was provided. Task completion time was best when physical force feedback was combined with augmented visual feedback. This research shows that when haptics is technologically limited, visual augmentation can be a good alternative source of force information in robotic surgery.