TITLE:

DOES THE METHOD OF VISUALIZATION IMPACT THE PERFORMANCE OF A NEW SURGICAL TASK IN NOVICE SUBJECTS?

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DISCLOSURE:

AMIN KASSAM REPORTS INVOLVEMENT AS A CONSULTANT TO SYNAPTIVE MEDICAL, KLS MARTIN MEDICAL, THE MEDTRONIC ADVISORY BOARD, AND FOUNDER AND CEO OF NEEKA HEALTH, LLC.
INTRODUCTION:

THIS PURPOSE OF THIS STUDY IS TO DETERMINE IF THERE IS A DIFFERENCE IN PERFORMANCE OF A SURGICAL TASK BY NAÏVE SUBJECTS WHEN USING AN OPERATING MICROSCOPE (3D PLATFORM) AND AN EXOSCOPE (2D PLATFORM).

WE WONDERED IF IT WOULD BE EASIER TO LEARN AND PERFORM A SURGICAL TASK USING A 3D OR A 2D OPTICAL PLATFORM.

WE WANTED TO COMPARE THE LEARNING CURVES FOR THE TWO PLATFORMS AND SEE IF THERE IS A TRANSFER EFFECT. THAT IS, DOES USING ONE MODALITY MAKE USING THE SECOND MODALITY EASIER?
METHODS:
THIS IS A PROSPECTIVE CROSSOVER, COUNTER-BALANCED TRIAL USING A REPEATED MEASURES APPROACH TO EXAMINE THE EFFECT OF CONVENTIONAL MICROSCOPE AND EXOSCOPE VISUALIZATION ON UNTRAINED SUBJECTS PERFORMING A SERIES OF SURGICAL TASKS.

WE ENROLLED VOLUNTEERS WITH NO SURGICALLY RELEVANT EXPERIENCE—HIGH SCHOOL AND COLLEGE STUDENTS.

TWO COHORTS OF EQUAL NUMBERS WITH EQUAL NUMBERS OF MEN AND WOMEN IN EACH COHORT WERE CREATED THROUGH RANDOM ALLOCATION.

GROUP 1 PERFORMED THE SURGICAL TASKS WITH THE EXOSCOPE FIRST FOLLOWED BY THE MICROSCOPE.
GROUP 2 PERFORMED THE SURGICAL TASKS FIRST WITH THE MICROSCOPE, THEN WITH THE EXOSCOPE.

THE SURGICAL TASK HAD TWO PARTS: PLACEMENT OF FOUR RUNNING SIMPLE STITCHES IN A SKIN SIMULATOR (LIMBS AND
THINGS, FIGURE 1) AND THEN TYING AN INSTRUMENT KNOT. EACH SURGICAL TASK WAS PERFORMED THREE TIMES.

TIME TO COMPLETE EACH TASK, GALVANIC SKIN RESPONSE (GSR) DURING EACH TASK, AND PERCEIVED EFFORT (AS MEASURED BY THE NASA-TLX SURVEY) AFTER USE OF EACH OPTICAL PLATFORM WERE RECORDED.

FIGURE 1. SURGICAL SKIN SIMULATOR
FIGURE 2. IN GENERAL, THE TIME TO COMPLETE EACH SURGICAL TASK WAS LONGER WITH THE EXOSCOPE THAN THE MICROSCOPE.

<table>
<thead>
<tr>
<th>Suture task</th>
<th>Knot tying task</th>
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<tbody>
<tr>
<td>Mean</td>
<td>SD</td>
</tr>
<tr>
<td>Group 1 ROF</td>
<td>379.3</td>
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<tr>
<td>MSS</td>
<td>129.2</td>
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<tr>
<td>Group 2 MSF</td>
<td>207.1</td>
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<tr>
<td>ROS</td>
<td>228.4</td>
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Abbreviations: MSF, microscope used first; MSS, microscope used second; ROF, ROVOT used first; ROS, ROVOT used second.
FIGURE 3. CHANGE IN PERCEIVED EFFORT AND WORKLOAD AFTER USING EACH MODALITY. IN GENERAL, PERFORMANCE WAS BETTER AND WORKLOAD LOWER WITH THE MICROSCOPE VS THE EXOSCOPE.

IN GROUP 1, THE GSR WAS APPROXIMATELY TWICE AS HIGH DURING MICROSCOPE USE COMPARED TO EXOSCOPE USE. IN GROUP 2, THERE WAS AN INCREASE IN GSR FROM MICROSCOPE TO ROVOT.
FIGURE 4. The learning curve for the suture task shows improvement in completion time with each repetition. For the knot tying task, the third repetition was faster than the first. Task completion was faster when a modality was used second vs first.
DISCUSSION/SUMMARY

SUBJECTS WITHOUT SURGICAL EXPERIENCE FOUND THAT PERCEIVED WORKLOAD WAS LESS WITH THE MICROSCOPE THAN WITH THE EXOSCOPE. TIME TO TASK COMPLETION WAS ALSO FASTER WHEN USING THE MICROSCOPE COMPARED TO THE EXOSCOPE.

TASK COMPLETION TIMES WERE FASTER WITH THE THIRD REPEITION THAN THE FIRST WITH EACH TASK AND EACH OPTICAL PLATFORM. (LEARNING CURVE)

TIME TO TASK COMPLETION WAS LOWER WHEN AN OPTICAL MODALITY WAS USED SECOND, COMPARED TO WHEN IT WAS USED FIRST. (TRANSFER EFFECT)

TWO AND THREE DIMENSIONAL SURGICAL OPTICAL PLATFORMS ARE NOT MUTUALLY EXCLUSIVE. TRAINING WITH EITHER PLATFORM WILL IMPROVE PERFORMANCE WITH THE OTHER.