INFLUENCE OF THE ENDOSCOPE’S STEREOSCOPIC BASIS ON PERFORMANCE OF STANDARDIZED LAPAROSCOPIC TASKS
A PROSPECTIVE RANDOMIZED CONTROLLED TRIAL

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Background

Various optics and monitor systems from HD-technology through to 3D-technology are available in minimal invasive surgery. There are studies already that have compared the 2D- with 3D-technology and demonstrated that 3D-technology improves time and learning curve of a surgical performance, but not its precision (Storz et al., 2012; Tanagho et al 2012; Bilgen et al. 2013).

Nevertheless, no study exists yet that deals with the influence of different plastic effects generated by the stereoscopic basis of a 3D-image during surgical performance.

The stereoscopic basis is defined as the distance of the two main points of a stereo optical system (see ILL 1). Its change results in a proportional change in three-dimensional effect (so called plastic effect).

Materials and methods

In our prospective randomized controlled trial we investigated the influence of the plastic effect caused by an altered stereoscopic basis on the performance of a standardized surgical task using the 3D-wavelength-division-multiplex-system (INFITEC GmbH, Ulm, Germany).

For this purpose n=20 medical students without laparoscopic prior knowledge were recruited and randomized in group 1 (n=10) with the setting-sequence b-a-c and group 2 (n=10) with the setting-sequence b-c-a. The settings were defined as follows:

Setting a: enlarged plastic effect
Setting b: typical plastic effect in laparoscopy (5 mm stereoscopic basis 3D-system)
Setting c: reduced plastic effect

The study participants had to perform intracorporeal laparoscopic simple interrupted sutures (see ILL. 2). The guidance was based on an instruction video and a poster. After passing the stereo vision test by Julesz for testing their ability of perception of depth on study-day 1 they performed the suture until reaching the learning curve. On study-day 2 the participants had to absolve 3 study-sutures per setting (b-a-c vs. b-c-a) after a repetition of the suture exercise.

Results

The total time needed for the performance of an intracorporeal laparoscopic simple interrupted suture in setting a was median 73.6 s, in setting b 75.7 s and in setting c 93.3 s. The time needed for step 1, which describes the time for doing the incision from the right to the left circuit-mark, was 18.5 s in setting a, 19.0 s in setting b and 25.2 s in setting c. The precision assessed using a scoring system was 47 points in setting a and 51 points in setting b as well as in setting c.

Therefore, there is a significant difference in the total time needed as well as in the time needed for step 1 between setting b and c.

<table>
<thead>
<tr>
<th>Setting</th>
<th>Total Time [s]</th>
<th>Time Step I [s]</th>
<th>Precision [points]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Setting a (enlarged plastic effect)</td>
<td>73.6</td>
<td>18.5</td>
<td>47</td>
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<tr>
<td>Setting b (typical plastic effect in laparoscopy)</td>
<td>75.7</td>
<td>19.0</td>
<td>51</td>
</tr>
<tr>
<td>Setting c (reduced plastic effect)</td>
<td>93.3</td>
<td>25.2</td>
<td>51</td>
</tr>
<tr>
<td>p 1</td>
<td>0.66</td>
<td>0.57</td>
<td>0.48</td>
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<td>p 2</td>
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<td>0.0265</td>
<td>0.85</td>
</tr>
</tbody>
</table>

TAB 1: Results (with p-values: p 1: setting b compared with setting a and p 2: setting b compared with setting c)

Conclusion

The present study demonstrates that the size of the stereoscopic basis of a laparoscopic 3D-system has an influence on the performance of standardized laparoscopic tasks. Even small changes in the size of the stereoscopic basis especially its reduction result in a significant difference in efficiency, less in precision. The 3D-image produced by a reduced stereoscopic basis causes a decreased visualization and as a consequence a significant worse efficiency.


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