MEASURING THE PERFORMANCE OF NEAR-INFRARED 3D OPHTHALMIC MICROSCOPE

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ABSTRACT

The research performed to measure the performance of subjective 3D visual images, which was obtained by near-infrared 3D ophthalmic microscope developed by previous research. Newly developed near-infrared 3D ophthalmic microscope has several advantages. First, eye surgery can be done in the dark room without visual light, so side effect could be reduced. Second, surgery can be more accurate and comfortable for doctor, because eyes can be seen on 3D display image. Third, near-infrared light help doctor to see more bright and clear image of eye lens and vitreous body. Experimental results showed that the subjective scores of near-infrared 3D image are superior to normal 3D color display.

KEYWORDS—3D Image, Near-infrared, Eye lens, Vitreous body, Surgical microscope.

I. INTRODUCTION

All kinds of eye surgeries are performed under the circumstance of visual light. Our research team developed new near-infrared 3D ophthalmic microscope that have several merits. Near-infrared light made it possible to perform an eye surgery in the dark room. Operating an eye surgery in the dark room could avoid side effect. Using 3D display image could support eye surgeon to execute an optic surgery more accurate and visible. To prove the benefits of a near-infrared 3D ophthalmic microscope, 80 people joined this experiment.

II. EXPERIMENTAL PROCESS

There are two subjective quality evaluation methods. One is DSCQS(Double Stimulus Continuous Quality Scale), the other one is ACR(Absolute Category Rating). ACR process applied in this experiment, due to more accurate quality evaluation is guaranteed. This experiment focused on transparency of the eye lens and vitreous body of an eye. When testing the performance of near-infrared 3D ophthalmic microscope, eye doctor could see clearer image of eye lens and vitreous body of an eye with near-infrared 3D ophthalmic microscope. Experiment includes 8 display images and 3 different images. The process of ACR method shown in Figure 1.

![Fig 1. Presentation of display sequence for the ACR Method](image)

Table 2 is the result of comparing image A and image B, second compare image A and image C, third compare image B and image C and then compare B and image C of vitreous body.

III. ANALYSIS AND RESULTS OF EXPERIMENT

A. Video A vs. Video B

Table 2 is the result of comparing image A and image B.
Figure 2 showed the box plot of image A and image B.

**TABLE 2. AVERAGE OF IMAGE A AND B**

<table>
<thead>
<tr>
<th>Video A</th>
<th>Video B</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.075±0.897</td>
<td>3.825±0.854</td>
<td>0.000</td>
</tr>
</tbody>
</table>

Average of image A and image B is 3.07 and 3.82, average of image B is higher than image A. P-value showed that these two images are statistically different.

### B. Video A vs. Video C

Table 3 is the result of comparing image A and image C. Figure 3 showed the box plot of image A and image C.

**TABLE 3. AVERAGE OF IMAGE A AND C**

<table>
<thead>
<tr>
<th>Video A</th>
<th>Video C</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.963±0.737</td>
<td>4.100±0.773854</td>
<td>0.000</td>
</tr>
</tbody>
</table>

Average of image A and image C is 2.96 and 4.10, average of image C is higher than image A. P-value showed that these two images are statistically different.

### C. Video B vs. Video C

Table 4 is the result of comparing image B and image C. Figure 4 showed the box plot of image B and image C.

**TABLE 4. AVERAGE OF IMAGE B AND C**

<table>
<thead>
<tr>
<th>Video B</th>
<th>Video C</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.713±0.917</td>
<td>3.65±1.02</td>
<td>0.0684</td>
</tr>
</tbody>
</table>

Average of image B and image C is 3.71 and 3.65, average of image C is higher than image B. P-value showed that these two images are statistically different.

### D. Video B vs. Video C(Vitreous body)

Table 5 is the result of comparing image A and image B of vitreous body. Figure 5 showed the box plot of image B and image C of vitreous body of an eye.

**TABLE 5. AVERAGE OF IMAGE B AND C**

<table>
<thead>
<tr>
<th>Video B</th>
<th>Video C</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.350±0.731</td>
<td>4.613±0.771</td>
<td>0.000</td>
</tr>
</tbody>
</table>
FIG 6. Image B and C of boxplot

Average of image B and image C is 3.35 and 4.61, average of image C is higher than image B. P-value showed that these two images are statistically different.

IV. CONCLUSION

Several experiments proved that near-infrared 3D ophthalmic microscope. Result of comparing image A and image B showed statistical different. It implied that near-infrared ray could provide more transparent and clear image of an eye to an eye surgery. Experiment of image A and C showed that when adding light visual ray to near-infrared ray, it is better than visual ray. However, comparing image B and C represented that there is no statistical different between two images. Lastly, analysis of image B and C of vitreous body proved that light visual ray showed more clear image of vitreous body of an eye. With all of the experiment result, near-infrared ray is better than visual ray and when adding light visual ray to near-infrared ray is better than near-infrared ray.

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REFERENCES


