Comparison of macular thickness maps of clinical SD-OCT and a low-cost self-administered OCT system

Macular thickness analysis (MTA) is a widely used tool for diagnosing and monitoring patients with ocular pathologies.

Here, we compare the performance of MTA of a commercial optical coherence tomography (OCT) device and a low-cost self-administered OCT prototype, through a subjective quality assessment of macular thickness maps (MTM) and statistical comparison of macular thickness values.

Quantitative and qualitative comparison between MTM of both systems, majority agreement (2 out of 3 graders) along with the survey questions are shown in Table 1.

In 87.5% of cases, the graders agreed that the MTM quality of low-cost prototype is similar to the CIRRUS HD-OCT system.

In 85% of cases, the graders agreed that they reach the same conclusion on fluid leakage of wAMD patient using MTM of both systems.

Bland-Altman analysis shows the mean differences in macular thickness measured range between -5.8 µm and 7.8 µm and $R^2$ values vary between 0.91 and 0.98 depending on the sector.

**PURPOSE**

**RESULTS**

**METHODS**

Study description:

- Participants: 18 subjects (31 eyes) with wet age-related macular degeneration (wAMD).
- Imaging devices: CIRRUS™ HD-OCT 5000 (ZEISS, Dublin, CA); low-cost OCT prototype system with self-triggered scan acquisition (ZEISS, Dublin, CA).
- Study procedure: For each eye on each scanning visit, an operator acquired one CIRRUS scan and subjects were asked to self-acquire OCT scans with the prototype system.
- The prototype system captured 5.78 mm x 5.78 mm OCT volumes with 512 A-scans/B-scan, 128 B-scans and 2.77 mm of depth.
- For each case, the resulting OCT volumes were segmented to delineate inner limiting membrane (ILM) and retinal pigment epithelium (RPE). The segmentation was used to generate macular thickness maps.
- The low-cost thickness map was registered to the CIRRUS scan and the ETDRS grid was centered on the CIRRUS scan.

Grading description:

- Three independent expert graders (optometrists) were asked for a subjective quality assessment of MTM generated by both systems.
- A correlation study and Bland-Altman analysis were used to compare the two groups of MTM.

**CONCLUSIONS**

This study demonstrates the ability of our low-cost OCT prototype to measure macular thickness with similar performance to that of a commercial OCT system for wet AMD monitoring.

**Table 1:** Quantitative and qualitative comparison of 40 pairs of MTM generated by both OCT systems.

<table>
<thead>
<tr>
<th>ETDRS sector</th>
<th>$R^2$</th>
<th>Regression slope and intercept</th>
<th>Mean difference (um)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Central</td>
<td>0.91</td>
<td>1.04 x - 10.40</td>
<td>-1.20</td>
</tr>
<tr>
<td>Inner Inferior</td>
<td>0.98</td>
<td>1.00 x - 3.00</td>
<td>-1.70</td>
</tr>
<tr>
<td>Inner Nasal</td>
<td>0.96</td>
<td>0.99 x - 2.00</td>
<td>-5.80</td>
</tr>
<tr>
<td>Inner Superior</td>
<td>0.98</td>
<td>0.99 x + 1.54</td>
<td>-2.40</td>
</tr>
<tr>
<td>Inner Temporal</td>
<td>0.96</td>
<td>0.93 x + 16.20</td>
<td>-4.10</td>
</tr>
<tr>
<td>Outer Inferior</td>
<td>0.97</td>
<td>1.01 x + 0.77</td>
<td>2.80</td>
</tr>
<tr>
<td>Outer Nasal</td>
<td>0.94</td>
<td>0.97 x + 8.33</td>
<td>1.00</td>
</tr>
<tr>
<td>Outer Superior</td>
<td>0.98</td>
<td>0.97 x + 8.09</td>
<td>0.84</td>
</tr>
<tr>
<td>Outer Temporal</td>
<td>0.95</td>
<td>0.98 x + 12.10</td>
<td>7.80</td>
</tr>
</tbody>
</table>

Qualitative comparison of MTM on both OCT systems

Question: Do you think MTM of low-cost OCT prototype is comparable with MTM of CIRRUS?

(5: Yes, with high confidence; 4: Yes, with low confidence; 3: Neutral, can’t assess; 2: No, with low confidence; 1: No, with high confidence)

Answers: 87.5% Yes, 12.5% No

Question: Do you think by using MTM of low-cost OCT prototype, you get to the same conclusion as using MTM of CIRRUS on fluid leakage of wAMD patient?

(5: Yes, with high confidence; 4: Yes, with low confidence; 3: Neutral, can’t assess; 2: No, with low confidence; 1: No, with high confidence)

Answers: 85% Yes, 15% No