Clinical Validity of Macular Ganglion Cell Complex by Spectral Domain Optical Coherence Tomography in Advanced Glaucoma
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INTRODUCTION

Glaucoma
- Structural and functional relationship
  - Optic nerve cupping + Corresponding VF deficits
  - RNFL loss precede the loss of visual function
  - Useful for diagnosis and management of glaucoma

Limitation of RNFL thickness measurement
- Thinned RNFL (advanced glaucoma)
- High myopia
- Peripapillary myelinated retina
- Peripapillary atrophy

Retinal ganglion cell (RGC) in macula
- More than 50% of the ganglion cells
- Ganglion layer is more than one-cell layer thickness
- Loss of the retinal ganglion cells in the posterior pole
- RGC bodies are 10 to 20 fold thicker than their axon

Macular ganglion cell death in glaucoma
- Preferentially affects 3 innermost retinal layer
  - The nerve fiber → Axon
  - Ganglion cell → Cell body
  - Inner plexiform layer → Dendrites

Macular ganglion cell complex (mGCC)

Spectral domain OCT (SD-OCT)
- Higher resolution and faster scan speed than TD-OCT
- 3D OCT-2000 (Topcon, Inc., Tokyo, Japan)
  - High-resolution objective and quantitative assessment of the mGCC

PURPOSE

To analyze the repeatability and diagnostic power of the measurement of the mGCC and pRNFL thickness using SD-OCT
To establish a highly repeatable and more diagnostic parameter in advanced glaucoma

SUBJECT & METHODS

40 glaucoma pts. (40 eyes) & 20 controls (20 eyes)

Inclusion criteria
- BCVA ≥ 0.3/2.0, Spherical refraction < ±6.0 D
- Normal group
  - No history of glaucoma or intraocular surgery
  - IOP ≤ 15mmHg
  - Non-glaucomatous optic nerve head
  - Normal VF test
  - Glaucoma group
  - Glaucomatous optic nerve damage with accompanying VF defects

Exclusion criteria
- History of other eye disease like cataract or media opacity
- Neurologic disease leading to VF abnormality

Advanced glaucoma
- Two subgroups based on MD
  - ≤ 20 dB ≤ MD < -10 dB
  - MD < -20 dB

Evaluation
- Best-corrected visual acuity and Manifest refraction
- IOP (Goldmann applanation tonometry)
- Slit lamp examination
- Gonioscopy
- Optic nerve head and RNFL examination with disc photography
- Swedish interactive thresholding algorithm (SITA) 30-2 perimeter ( Humphrey Field Analyzer [Carl Zeiss])

3D OCT scanning (Topcon)
- After pupil dilation
- Four scans per eye on 4 days within 1 month
- pRNFL thickness & mGCC thickness measurement
  - Total / Superior / Inferior

Statistics
- SPSS version 12.0 & Medcalc version 9.6
- One-way ANOVA and Chi-square test
- Repeatability
  - Coefficient of variation (CV)
  - Intraclass correlation coefficient (ICC)
- Diagnostic power
  - Area under the receiver operating characteristic curve (AROC)
  - Delong test was used to determine statistical difference between AROC

P value <0.05

RESULTS

Baseline patients characteristics

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Normal (N=20)</th>
<th>20dB≤MD&lt;10dB (N=20)</th>
<th>MD&lt;–20dB (N=20)</th>
<th>P1</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Refractive error, D</td>
<td>–3.43±1.34</td>
<td>–1.43±3.24</td>
<td>1.6 ±2.0</td>
<td>0.475</td>
<td>0.365</td>
<td>0.775</td>
</tr>
<tr>
<td>IOP(mmHg)</td>
<td>14.92±2.81</td>
<td>14.88±2.6</td>
<td>15.03±6.4</td>
<td>0.369</td>
<td>0.556</td>
<td>0.737</td>
</tr>
<tr>
<td>Visual field, dB</td>
<td>–1.02±1.73</td>
<td>–1.50±1.02</td>
<td>–1.77±1.83</td>
<td>0.059</td>
<td>0.059</td>
<td>0.059</td>
</tr>
<tr>
<td>P3, Delong test</td>
<td>0.001</td>
<td>0.001</td>
<td>0.001</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mGCC thickness, μm</td>
<td>Total</td>
<td>108.38±13.90</td>
<td>93.26±20.15</td>
<td>131.71±6.02</td>
<td>0.001</td>
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<tr>
<td>Superior</td>
<td>129.47±13.87</td>
<td>104.86±15.70</td>
<td>89.54±18.59</td>
<td>0.001</td>
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<td>Inferior</td>
<td>111.75±15.01</td>
<td>101.91±20.67</td>
<td>89.51±17.49</td>
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The nerve fiber thickness & parameters value <0.05

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Total number of controls & patients

| ROC curves of best variables from the 3D OCT
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AROC of pRNFL and mGCC Thickness

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CONCLUSION

In advanced glaucoma, the measurement of pRNFL thickness and mGCC thickness had similar favorable diagnostic power

In the far-advanced group of MD below -20dB, the repeatability of mGCC parameters was not as good as that of pRNFL's

Our results differ from those of previous observations
- Far-advanced glaucoma patients
  - Extensive structural damages (susceptible to the ‘floor’ effect)
  - Only 50% of the RGCs are present in the macular area
  - mGCC thickness tend to have less signal-to-noise rather than those related with pRNFL thickness

For monitoring the progression of glaucoma, pRNFL parameters are better than mGCC parameters in advanced glaucoma