# Analysis of choroidal maps and fundus autofluorescence correlates in non-exudative age-related macular degeneration using swept source optical coherence tomography

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**Purpose:** To analyze choroidal thickness maps (CMs) and fundus autofluorescence (FAF) in patients with non-exudative age-related macular degeneration (AMD) using swept source optical coherence tomography (Swept-OCT).
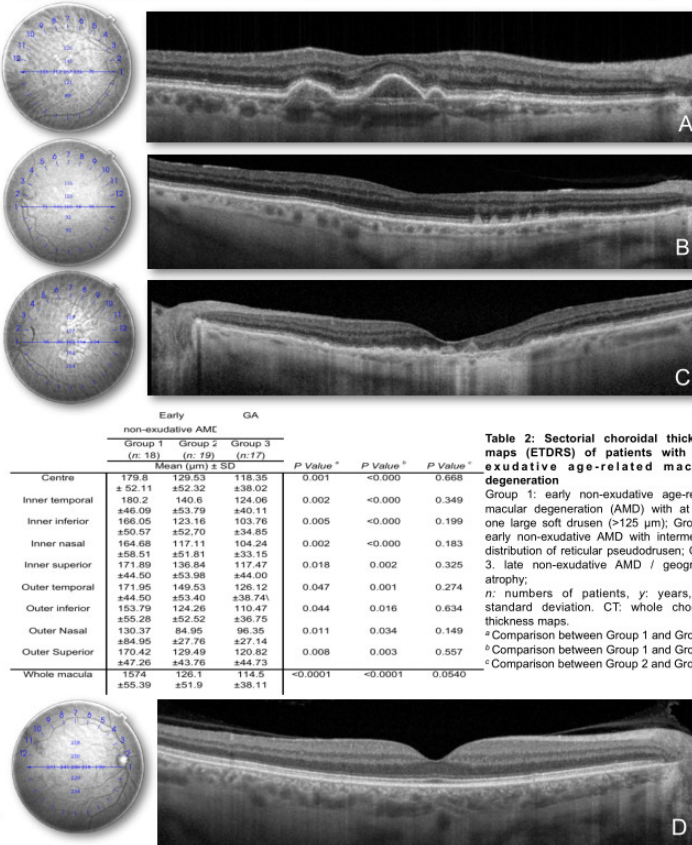
**Methods:** CMs imaging were obtained using Swept-OCT (Topcon Medical Systems, Oakland, NJ). A standardized imaging protocol was performed in all patients: radial diameter 9.0 mm scans through the foveal center with automated ETDRS choroidal thickness map (9 sectors). FAF images obtained using Spectralis HRA+OCT (Heidelberg Engineering, Heidelberg, Germany) were overlay with Swept-OCT. Eyes were divided in: Group 1, early non- exudative AMD with at least one large soft drusen (>125 μm); Group 2, early non-exudative AMD with intermediate distribution of reticular pseudodrusen; Group 3, late non-exudative AMD / Geographic atrophy (GA); and Group 4, control subjects with no ocular diseases The mean thickness was automatically measured in the "center" sector within 1 mm from the center of the fovea, in 4 "inner ring" sectors (superior, inferior, nasal, and temporal; 1 to 2 mm from the center of the fovea), and in 4 "outer ring" sectors (superior, inferior, temporal, and nasal; 2 to 3 mm from the center of the fovea).

**Results**: A total of 72 eyes of 72 consecutive patients with non-exudative AMD (48 females; mean age 79.1±8.1 years) were included in the analysis (table 1). The mean whole choroidal thickness were 157 ± 55 μm, 126 ± 51 μm, 114 ± 38 μm et 188 ± 74 μm (in group 1,2,3 and 4 respectively). The CMs were significantly reduced in Group 2, and 3 compared with group 1 (table 2) and 4 (table 3) (p <0.05). On the basis of FAF features in Group 3, a total of 70 ETDRS sectors were categorized as hypo-FAF (sectors characterized by > 50% absence of FAF), and 83 ETDRS sectors were categorized as hyper/iso-FAF (sectors characterized by ≤ 50% absence of FAF). No statistical differences in CMs were found among ETDRS sectors with >50% and <50% atrophic (HypoFAF) or preserved retina (Hyper/IsoFAF) in GA group (p 0.07).



**Figure 1.** Choroidal maps (CMs) (left panel) in non-exudative age-related macular degeneration and normal subjects using Swept source OCT (swept-OCT). Sub-foveal B-Scan (right panel) for each group: Group 1 (A), early non- exudative AMD with at least one large soft drusen (>125 μm); Group 2 (B), early non-exudative AMD with intermediate distribution of reticular pseudodrusen; Group 3 (C), late non-exudative AMD / Geographic atrophy (GA); and Group 4 (D), control subjects.
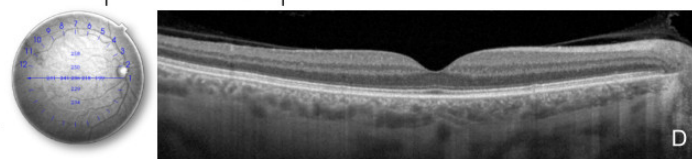


**Figure 2.** (A) Fundus auto-florescence (FAF) (orange circle) images obtained using Spectralis HRA+OCT were overlaid with Swept-OCT IR image (green cicle) in late non-exudative (late-AMD) group. On the basis of FAF features ETDRS sectors were categorized as hypo-FAF (sectors characterized by > 50% absence of FAF), or hyper/iso-FAF (sectors characterized by ≤ 50% absence of FAF) (Table 4). Choroidal maps (CMs) were analyzed. No statistical differences in CMs were found among ETDRS sectors with >50% and <50% atrophic (HypoFAF) or preserved retina (Hyper/IsoFAF) in GA group. CMs seem to be not associated with FAF features in eyes with late-AMD.

## Table 2: Sectorial choroidal thickness maps (ETDRS) of patients with non-exudative age-related macular degeneration

|  | Group 1 (n: 18) | Group 2 (n: 19) | Group 3 (n:17) | | | |
|---|---|---|---|---|---|---|
|  | Mean (μm) ± SD | | | P Value [a] | P Value [b] | P Value [c] |
| Centre | 179.8 ± 52.11 | 129.53 ±52.32 | 118.35 ±38.02 | 0.001 | <0.000 | 0.668 |
| Inner temporal | 180.2 ±46.09 | 140.6 ±53.79 | 124.06 ±40.11 | 0.002 | <0.000 | 0.349 |
| Inner inferior | 166.05 ±50.57 | 123.16 ±52.70 | 103.76 ±34.85 | 0.005 | <0.000 | 0.199 |
| Inner nasal | 164.68 ±58.51 | 117.11 ±51.81 | 104.24 ±33.15 | 0.002 | <0.000 | 0.183 |
| Inner superior | 171.89 ±44.50 | 136.84 ±53.98 | 117.47 ±44.00 | 0.018 | 0.002 | 0.325 |
| Outer temporal | 171.95 ±44.50 | 149.53 ±53.40 | 126.12 ±38.74\ | 0.047 | 0.001 | 0.274 |
| Outer inferior | 153.79 ±55.28 | 124.26 ±52.52 | 110.47 ±36.75 | 0.044 | 0.016 | 0.634 |
| Outer Nasal | 130.37 ±84.95 | 84.95 ±27.76 | 96.35 ±27.14 | 0.011 | 0.034 | 0.149 |
| Outer Superior | 170.42 ±47.26 | 129.49 ±43.76 | 120.82 ±44.73 | 0.008 | 0.003 | 0.557 |
| Whole macula | 1574 ±55.39 | 126.1 ±51.9 | 114.5 ±38.11 | <0.0001 | <0.0001 | 0.0540 |

Group 1: early non-exudative age-related macular degeneration (AMD) with at least one large soft drusen (>125 μm); Group 2: early non-exudative AMD with intermediate distribution of reticular pseudodrusen; Group 3. late non-exudative AMD / geographic atrophy;
n: numbers of patients; y: years, SD: standard deviation. CT: whole choroidal thickness maps.
[a] Comparison between Group 1 and Group 2
[b] Comparison between Group 1 and Group 3
[c] Comparison between Group 2 and Group 3

## Table 4. Comparisons of sectorial choroidal thickness maps (ETDRS) in patients with late non-exudative age-related macular degeneration / geographic atrophy according to fundus-autoflourescence (FAF) features.

|  | Hypo-FAF | Hyper/iso FAF | P Value |
|---|---|---|---|
|  | Mean (μm) ± SD | | |
| Centre | 119 ± 36.91 (14)* | 116 ± 51.97 (3) | 0.705† |
| Inner temporal | 114 ± 45.18 (8) | 133 ± 35.35 (9) | 0.500 |
| Inner inferior | 98 ± 32.34 (11) | 113 ± 40.31 (6) | 0.450 |
| Inner nasal | 111 ± 32.76 (12) | 89 ± 32.31 (5) | 0.205 |
| Inner superior | 118 ± 47.94 (13) | 115 ± 33.49 (4) | 1.000 |
| Outer temporal | 77 ± 39.83 (5) | 136 ± 30.45 (12) | 0.016 |
| Outer inferior | 101 ± 29.93 (6) | 116 ± 40.33 (11) | 0.392 |
| Outer Nasal | 97 ± 31.68 (8) | 96 ± 23.11 (9) | 0.885 |
| Outer Superior | 128 ± 48.22 (7) | 116 ± 44.12 (10) | 0.379 |
| Whole macula | 109 ± 38.65 (83) | 117 ± 37.29 (70) | 0.328 |

"Hypo-FAF": ETDRS sectors characterized by > 50% absence of FAF; "Hyper/iso FAF": ETDRS sectors characterized by ≤ 50% absence of FAF; *: numbers of sectors ETDRS; SD: standard deviation; †: Two-sample Wilcoxon test rank-sum (Mann-Whitney) test.

## Table 3. Sectorial Choroidal thickness maps (ETDRS) of patients with non-exudative age-related macular degeneration

|  | Group 1 (n: 18) | Group 2 (n: 19) | Group 3 (n: 17) | Group 4 (n:17) | | | |
|---|---|---|---|---|---|---|---|
|  | Mean (μm) ± SD | | | | P Value [a] | P Value [b] | P Value [c] |
| Centre | 179.8 ± 52.11 | 129.53 ±52.32 | 118.35 ±38.02 | 201.72 69.08 | 0.001 | 0.018 | <0.000 |
| Inner temporal | 180.2 ±46.09 | 140.6 ±53.79 | 124.06 ±40.11 | 198.7 ±68.65 | 0.002 | 0.028 | <0.000 |
| Inner inferior | 166.05 ±50.57 | 123.16 ±52.70 | 103.76 ±34.85 | 186.44 ±78.87 | 0.005 | 0.043 | <0.000 |
| Inner nasal | 164.68 ±58.51 | 117.11 ±51.81 | 104.24 ±33.15 | 184.00 ±76.45 | 0.002 | 0.042 | <0.000 |
| Inner superior | 171.89 ±44.50 | 136.84 ±53.98 | 117.47 ±44.00 | 202.22 ±63.77 | 0.018 | 0.043 | 0.002 |
| Outer temporal | 171.95 ±44.50 | 149.53 ±53.40 | 126.12 ±38.74\ | 181.72 ±66.57 | 0.047 | 0.011 | 0.001 |
| Outer inferior | 153.79 ±55.28 | 124.26 ±52.52 | 110.47 ±36.75 | 166.28 ±77.69 | 0.044 | 0.032 | 0.016 |
| Outer Nasal | 130.37 ±84.95 | 84.95 ±27.76 | 96.35 ±27.14 | 151.39 ±77.24 | 0.011 | 0.033 | 0.034 |
| Outer Superior | 170.42 ±47.26 | 129.49 ±43.76 | 120.82 ±44.73 | 201.44 ±76.34 | 0.008 | 0.01 | <0.000 |
| Whole macula | 157.4 ±55.39 | 126.1 ±51.9 | 113.5 ±38.11 | 188.22 ±74.08 | <0.0001 | <0.0001 | <0.000 |

Group 1: early non-exudative age-related macular degeneration (AMD) with at least one large soft drusen (>125 μm); Group 2: early non-exudative AMD with intermediate distribution of reticular pseudodrusen; Group 3. late non-exudative AMD / geographic atrophy; Group 4: control subjects with no ocular diseases.
n: numbers of patients; y: years, SD: standard deviation. CT: whole choroidal thickness maps.
[a] Comparison between Group 1 and Group 4
[b] Comparison between Group 2 and Group 4
[c] Comparison between Group 3 and Group 4

## Table 1: Demographics and clinical features of study patients

|  | Group 1 (n: 18) | Group 2 (n: 19) | Group 3 (n: 17) | Group 4 (n: 18) | P Value |
|---|---|---|---|---|---|
| Male-to-female ratio | 7/18 | 7/19 | 5/17 | 5/18 | 0.5 † |
| Mean age, (y) ± SD | 79.0 ±6.82 | 84.0 ±6.55 | 75.9 ±9.81 | 76.7 ±8.91 | 0.154 †† |
| BCVA (LogMAR) ± SD | 0.19* ±0.16 | 0.25* ±0.18 | 0.71 ±0.39 | 0.03* ±0.05 | <0.001 †† |

Group 1: early non-exudative age-related macular degeneration (AMD) with at least one large soft drusen (>125 μm); Group 2: early non-exudative AMD with intermediate distribution of reticular pseudodrusen; Group 3: late non-exudative AMD / geographic atrophy; Group 4: control subjects with no ocular diseases.
n: numbers of patients; y: years; SD: standard deviation; †: X2 test; ††: Wilcoxon test; *: comparison between all patients with non-exudative AMD and control subjects with no ocular diseases (Group 4); BCVA: Best-corrected visual acuity; LogMAR: logarithm of minimal angle of resolution; *:comparison between group 3 and all other groups.

## Conclusion:

CMs reveal a thinner choroid in eyes with GA early Pseudodrusen patients compared with drusen and control subjects on swept OCT. CM in the different ETDRS sectors was not associated with FAF features in eyes with GA.

**References:**
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