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Subfoveal suprachoroidal space and choroidal thickness changes after a near-vision task in healthy young adults

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ABSTRACT

Aims: To evaluate subfoveal suprachoroidal space (SCS) and choroidal thickness (ChT) changes immediately after a near-vision task.

Methods: This prospective within-subject before-and-after study included one eye from each of 74 healthy adults aged 18-40 years. After 5 minutes of seated rest, a baseline structural macular optical coherence tomography scan was obtained. Participants then completed a 3-minute near-vision task using a high-contrast target at 33 cm, and the scan was repeated immediately after the task. SCS and choroidal thicknesses were measured by two masked graders. The primary outcome was within-eye SCS thickness change from baseline, assessed with a paired t-test. Choroidal thickness change and the Pearson correlation between changes in the two thickness measurements were also evaluated.

Results: The study included 74 participants (36 male and 38 female) with a mean age of 28.6±6.4 years. SCS thickness increased from 29.8±6.8 to 41.2±8.9 µm (mean change, +11.4 µm; 95% CI, 10.6-12.3 µm; p<.001). ChT decreased from 258.4±64.2 to 231.6±58.8 µm. ΔChT and ΔSCS were negatively correlated (r=-0.64; 95% CI, -0.76 to -0.48; p<.001). The visible-SCS subgroup (n=65) showed a similar correlation (r=-0.65).

Conclusion: The post-task SCS increase and ChT decrease were negatively correlated. These exploratory associations do not establish mechanical coupling or volume redistribution.

Keywords: Accommodation, near work, suprachoroidal space, choroidal thickness, optical coherence tomography

INTRODUCTION

Near viewing increases accommodative demand and is accompanied by ciliary muscle contraction, convergence, pupillary constriction, and small changes in posterior ocular biometry. Controlled optical-stimulus and sustained near-work studies have reported changes in axial length and choroidal thickness (ChT), although their magnitude depends on stimulus strength, task duration, refractive correction, and image-acquisition timing.[1,2]

The suprachoroidal space (SCS) lies between the choroid and sclera and contributes to uveoscleral fluid pathways.[3] Enhanced-depth optical coherence tomography (OCT) can show a hyporeflective suprachoroidal layer in some healthy eyes, although visibility and measured thickness depend on age, device characteristics, image quality, and boundary definitions.[4,5] The SCS has also attracted interest as a route for posterior-segment drug delivery, making reliable description of its normal anatomy relevant.[6]

Liu and colleagues[2] evaluated choroidal metrics before and immediately after supervised near work at 33 cm, thereby separating the near-vision task from OCT acquisition. Whether the OCT-defined subfoveal SCS measurement also changes immediately after a standardized near-vision task has not been well characterized.

The principal outcome in this focused report was the paired change in subfoveal SCS thickness immediately after a 3-minute near-vision task in adults aged 18-40 years. Secondary exploratory outcomes were the paired change in subfoveal ChT and the association between ΔChT and ΔSCS.

METHODS

Ethics

The protocol was approved by the Van Training and Research Hospital Non-interventional Clinical Researches Ethics Committee (Date: 03.04.2026, Decision No: GOKAEK/2026-04-03), and written informed consent was obtained from all

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participants. Recruitment, consent, and all research-specific procedures began after ethics approval. The study adhered to the principles of the Declaration of Helsinki.

Study Design and Participants

This prospective within-subject before-and-after study was conducted in the Department of Ophthalmology of a tertiary training and research hospital.

Seventy-four eligible participants aged 18-40 years were enrolled after ethics approval. One eye per participant was included; when both eyes were eligible, the right eye was selected to avoid within-participant inter-eye dependence.

Eligibility criteria were best-corrected visual acuity (BCVA) of 1.0 decimal (0.00 logMAR; 20/20), spherical equivalent between -6.00 and +3.00 diopters, astigmatism less than 1.50 diopters, clear ocular media, and no ocular disease on examination. Refractive error was not an exclusion criterion within these limits; appropriate spectacle correction was worn during the near-vision task. Exclusion criteria were previous ocular surgery, systemic disease or medication likely to influence ciliary muscle function or choroidal physiology, contact-lens wear within 72 hours, pregnancy or breastfeeding, inability to complete imaging, or inadequate OCT image quality. Participants were asked to avoid caffeine, alcohol, tobacco, and strenuous exercise for 12 hours before imaging.

Ocular Assessment and Near-Vision Protocol

All examinations were performed between 9:00 AM and 12:00 PM. Baseline evaluation included refraction, best-corrected visual acuity, slit-lamp examination, Goldmann applanation tonometry, and optical biometry with the Lenstar LS 900 (Haag-Streit AG, Koeniz, Switzerland). Structural OCT was obtained with the SOLIX spectral-domain OCT system (Optovue Inc., Fremont, CA, USA; axial resolution approximately 5 μm). No mydriatic or cycloplegic agent was administered before the OCT measurements, and dilated fundus examination was not performed as part of the study visit.

After 5 minutes of seated rest, participants were positioned at the OCT device and a baseline foveal B-scan was acquired without spectacles. Participants then viewed a high-contrast, 6/6-equivalent near target at 33 cm for 3 minutes while wearing spectacles correcting their distance refractive error and were instructed to maintain clear, single vision. Immediately after task completion, the spectacles were removed, participants were repositioned at the OCT device, and a second foveal B-scan was acquired. Thus, both OCT measurements were performed without spectacles, whereas the intervening near-vision task was performed with spectacle correction. OCT was acquired after the task rather than simultaneously with near viewing. This acquisition sequence follows the post-near-work approach described by Liu and colleagues,[2] while retaining the 3-minute task used in the present study. The target distance represented a nominal 3.0 D accommodative stimulus; the accommodative response was not objectively quantified.

Image Analysis

Baseline and immediate post-task B-scans were de-identified and graded independently by two experienced observers masked to image condition. A senior grader adjudicated discrepancies greater than 5 μm. The outer choroidal boundary was identified at the transition from hyporeflective choroidal vasculature to the more homogeneous hyperreflective sclera. Subfoveal ChT was defined as the distance from the outer retinal pigment epithelium (RPE) border to this choroidal boundary. SCS thickness was defined as the distance from the outer choroidal boundary to the inner scleral surface. Both measurements were made at the foveal center on the same baseline and post-task B-scans using the built-in digital caliper. These definitions treat ChT and SCS thickness as adjacent measurements with a shared boundary.

A distinct hyporeflective SCS band was recorded as visible or non-visible. When no distinct band was visible, the minimum separation between the outer choroidal stroma and inner scleral surface was recorded. Because this surrogate may not represent the same anatomical construct as a visible SCS band, sensitivity results for both the SCS change and the ΔChT-ΔSCS association are presented for eyes with a visible band.

Intergrader agreement was estimated with a two-way random-effects intraclass correlation coefficient for absolute agreement. Intragrader agreement was assessed when the senior grader repeated measurements from 40 stored scans after 2 weeks. These analyses quantify grader-related segmentation agreement on the same images; they do not estimate test-retest acquisition variability.[7]

Statistical Analysis

Continuous variables were expressed as mean±standard deviation (SD), and categorical variables as counts and percentages. Within-eye change (Δ) was defined as immediate post-task minus baseline. The primary outcome was subfoveal SCS thickness change. ChT change and the ΔChT-ΔSCS association were exploratory secondary outcomes.

SCS change estimates were calculated from subgroup sample sizes, mean within-eye changes, and corresponding SDs. The overall mean and variance incorporated both within-subgroup and between-subgroup variation. Paired t statistics and 95% confidence intervals (CIs) were calculated for SCS change. Differences between the visible-SCS and non-visible-SCS subgroups were evaluated using Welch's t-test.

ChT changes were presented using the available paired mean difference, 95% CI, and p-value. The association between ΔChT and ΔSCS was expressed using Pearson's correlation coefficient. Correlation CIs were calculated using Fisher's z transformation, and two-sided p-values were derived from the coefficients and sample sizes. A sensitivity analysis was restricted to eyes with a visible SCS.

All secondary analyses were exploratory, without adjustment for multiple comparisons. Individual-level data were not reanalyzed, so distributional assumptions and the influence of outliers could not be reassessed.

RESULTS

Participant Characteristics

Seventy-four participants (36 male and 38 female) were included. Mean age was 28.6±6.4 years, mean spherical equivalent was -1.18±1.88 diopters, and mean axial length was 23.7±1.0 mm (Table 1).

Table 1. Demographic and baseline ocular characteristics (n=74)

Parameter	Mean±SD or n (%)	Range
Age, years	28.6±6.4	18-40
Gender, male/female	36 (48.6)/38 (51.4)	-
Spherical equivalent, D	-1.18±1.88	-5.88 to +2.96
Axial length, mm	23.7±1.0	21.9-26.2
Baseline intraocular pressure, mmHg	13.0±3.8	6.0-22.0
Baseline subfoveal SCS thickness, µm	29.8±6.8	3.2-46.8
Baseline subfoveal ChT, µm	258.4±64.2	112.6-468.3

Values are retained from the reported cohort summaries. SD: Standard deviation, D: Diopters, SCS: Suprachoroidal space, ChT: Choroidal thickness

Subfoveal Suprachoroidal Space (SCS) Thickness

Mean subfoveal SCS thickness increased from 29.8±6.8 µm at baseline to 41.2±8.9 µm immediately after the 3-minute near-vision task. The paired mean change was +11.4±3.7 µm (95% CI, 10.6-12.3 µm; p<.001). An increase occurred in 70 of 74 eyes (94.6%) (Table 2; Figure 1A).

Table 2. Subfoveal SCS and choroidal thickness before and immediately after the 3-minute near-vision task (n=74)

Measure	Baseline mean±SD	Post-task mean±SD	Mean paired change	95% CI of change	p-value
SCS thickness	29.8±6.8	41.2±8.9	+11.4	10.6 to 12.3	<.001
ChT	258.4±64.2	231.6±58.8	-26.8	-31.2 to -22.4	<.001

All thickness values and changes are in µm. Change=Immediate post-task-baseline. SCS change statistics were estimated from rounded subgroup summaries; ChT results were retained from the original analysis. SCS: Suprachoroidal space, SD: Standard deviation, CI: Confidence interval, ChT: Choroidal thickness

A distinct hyporeflective SCS band was visible in 65 eyes (87.8%); a minimum-separation surrogate was used in the remaining 9 eyes. Mean changes were +11.6±3.7 µm in the visible-SCS subgroup (95% CI, 10.7-12.5 µm; p<.001) and +10.2±3.2 µm in the non-visible subgroup. The between-subgroup difference was 1.4 µm (95% CI, -1.2 to 4.0 µm; p=.25). This comparison does not establish equivalence between the two measurement approaches.

Intergrader and intragrader intraclass correlation coefficients for SCS measurements on stored images were 0.96 (95% CI, 0.94-0.98) and 0.97 (95% CI, 0.95-0.98), respectively. For ChT, both coefficients were 0.98 (95% CI, 0.97-0.99).

Subfoveal Choroidal Thickness

Reported mean subfoveal ChT decreased from 258.4±64.2 µm at baseline to 231.6±58.8 µm immediately after the task (mean paired change, -26.8 µm; reported 95% CI, -31.2 to -22.4 µm; p<.001). A decrease was reported in 68 of 74 eyes (91.9%) (Table 2; Figure 1B).

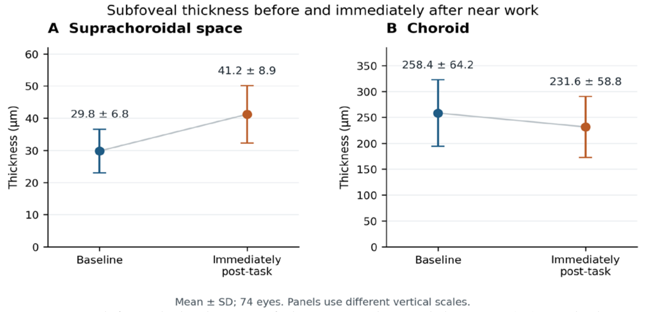

Figure 1. Subfoveal thickness of the suprachoroidal space (A) and choroid (B) before and immediately after the near-vision task (74 eyes). Points and error bars show mean±SD; lines connect group means. Panels use different vertical scales

SD: Standard deviation

Association Between ΔChT and ΔSCS

The reported correlation between subfoveal ΔChT and ΔSCS was r=-0.64. The approximate Fisher 95% CI calculated from r and n=74 was -0.76 to -0.48 (p<.001). Thus, larger SCS increases were associated with more negative ChT changes. In the reported analysis restricted to 65 eyes with a visible SCS band, r was -0.65 (approximate 95% CI, -0.77 to -0.48; p<.001) (Table 3; Figure 2). These coefficients describe association and do not quantify transfer of tissue or fluid between compartments.

Table 3. Association between within-eye changes in subfoveal ChT and SCS thickness

Analysis set	n	Pearson r	Approximate 95% CI	p-value
All eyes	74	-0.64	-0.76 to -0.48	<.001
Visible SCS only	65	-0.65	-0.77 to -0.48	<.001

Δ=Immediate post-task-baseline. Approximate CIs and p-values were calculated from reported r and n. The visible-SCS subgroup is included in the full cohort. ChT: Choroidal thickness, SCS: Suprachoroidal space, CI: Confidence interval

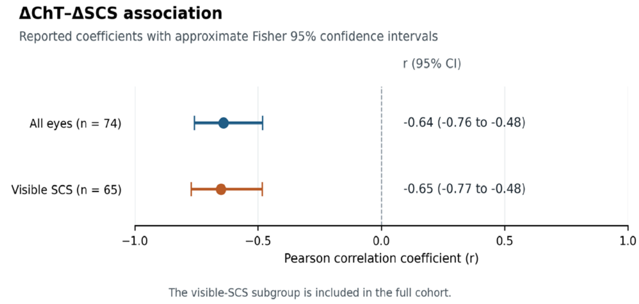

Figure 2. Correlation between changes in subfoveal ChT (ΔChT) and SCS thickness (ΔSCS). Points and bars show reported Pearson r and approximate 95% CIs for the full cohort (74 eyes) and its visible-SCS subgroup (65 eyes)

Δ=Immediate post-task-baseline, ChT: Choroidal thickness, SCS: Suprachoroidal space, CI: Confidence interval

DISCUSSION

Subfoveal SCS thickness increased and ChT decreased immediately after the 3-minute near-vision task, with mean changes of +11.4 µm and -26.8 µm, respectively. The within-eye changes were negatively correlated (r=-0.64), and a similar association was present in eyes with a visible SCS band. These observations describe a post-task association but do not identify the physiological pathway responsible for it.

Woodman-Pieterse and colleagues[1] observed choroidal thinning during a 6-D accommodative stimulus, whereas Liu and colleagues[2] acquired OCT after near work and found a mean subfoveal ChT decrease of 5.1 µm after 20 minutes in myopic adults. The direction of the ChT change in the present study is consistent with these observations, but its magnitude was greater despite the shorter task. Differences in stimulus duration, refractive characteristics, imaging platform, boundary definitions, and acquisition timing limit direct comparison. The shared direction of change does not validate the magnitude observed here; independent replication is needed.

Possible explanations for the post-task changes include ciliary muscle-related mechanical effects on the choroid and sclera, convergence-related forces, and autonomic or vascular responses to near viewing.[8,9] The 33-cm target provided a nominal accommodative stimulus, but the actual response was not measured. Because OCT was obtained after task completion, the observations may reflect residual or recovering responses and cannot be interpreted as direct measurements during sustained accommodation.

Başkan and colleagues[10] reported an association between greater IOP increases and greater choroidal thinning following cervical flexion in healthy adults. Ha and colleagues[11] also reported transient IOP elevation during smartphone-based near work, with larger increases associated with greater neck flexion. These findings raise the possibility that an IOP rise accompanying near work could contribute to choroidal thinning. However, the exposures differed from the present task, and neither post-task IOP nor neck position was included in our analysis. A pressure-related contribution therefore remains a hypothesis; an IOP increase in this cohort cannot be assumed.

The negative ΔChT-ΔSCS correlation also requires caution because the measurements share the outer choroidal boundary. Placing this boundary more anteriorly decreases measured ChT and increases measured SCS thickness, even if the RPE and inner scleral positions are unchanged. Correlated boundary-placement errors could therefore contribute to the inverse association. Restricting the analysis to eyes with a visible SCS band does not remove this dependence. The correlation and the changes in linear thickness do not establish fluid transfer, mechanical coupling, or volume redistribution between compartments.

The SCS band was visible in 87.8% of eyes, compared with 44.6% in the cohort studied by Yiu and colleagues.[4] Differences in the study populations, imaging platforms, and boundary criteria limit direct comparison of these proportions. The positive SCS change in the visible-band subgroup indicates that the overall finding was not confined to surrogate measurements. Nevertheless, the small non-visible subgroup and the non-significant between-subgroup comparison do not establish that minimum separation and visible-band thickness represent equivalent anatomical measurements.

Strengths include the use of one eye per participant, within-eye comparisons, a morning examination window, a fixed task duration and target distance, and masked grading. The high agreement on stored scans supports consistency between readers, in keeping with work on manual choroidal thickness measurement.[7] These features improve comparability, but grader agreement does not quantify variability introduced by acquiring a new scan.

Limitations

The principal limitations are the absence of objective accommodation measurements, a single post-task assessment, the lack of a time-matched control and independent repeat acquisitions, manual boundary identification, and use of a surrogate when the SCS band was not visible. Spectacle removal and repositioning introduced a task-to-scan delay that was not quantified. Although the intended sequence was immediate post-task imaging, its exact latency was not established and may have influenced the measurements. The single-center, young-adult sample also limits generalizability.

Individual-level data were not reanalyzed, so data consistency, distributional assumptions, and influential observations could not be independently assessed. The paired ChT CI and p-value were not independently recalculated. Secondary analyses were exploratory, with no adjustment for multiple comparisons. The findings should therefore be considered hypothesis-generating and do not establish normative values or clinical applications.

CONCLUSION

Subfoveal SCS thickness increased and ChT decreased after the 3-minute near-vision task, and the within-eye changes were negatively correlated. The association does not distinguish physiological coupling from shared-boundary measurement effects or other influences accompanying near work. Confirmation requires verification against individual-level measurements, objective assessment of accommodation and IOP, documented task-to-scan timing, independent repeat acquisitions, and a time-matched control condition.

ETHICAL DECLARATIONS

Ethics Committee Approval

This study was approved by the Van Training and Research Hospital Non-interventional Clinical Researches Ethics Committee (Date: 03.04.2026, Decision No: GOKAEK/ 2026-04-03).

Informed Consent

Written informed consent was obtained from all individual participants prior to their inclusion in the study. Participants were fully informed about the study's aims, procedures, potential risks and benefits, and their rights-including the right to withdraw at any time without consequence. All participants voluntarily signed a written informed consent form.

Peer Review Process

This manuscript was subject to external peer review.

Conflict of Interest

The authors declare no conflicts of interest related to this study.

Financial Disclosure

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Author Contributions

Concept: YE; Design: YE; Control: YE; Resources: YE, İY; Materials: YE; Data Collection and/or Processing: YE; Analysis and/or Interpretation: YE; Literature Review: İY; Writing the Article: İY, MG; Critical Review: İY.

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