

UK Biobank

Optical Coherence Tomography Scan and Retinal Imaging

Version 1.0

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This manual details the procedure for Optical Coherence Tomography Scan and Retinal Imaging at an Assessment Centre of the UK Biobank.

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1. Introduction

1.1: This manual details the procedure for Optical Coherence Tomography Scan and Photography of the Retina at an Assessment Centre of the UK Biobank. This takes place at the 4th 'station' of the Assessment Centre visit, as listed in Table 1.

Table 1: sequence of assessment visit

	Visit station	Assessments undertaken
1	Reception	<ul style="list-style-type: none"> • Welcome & registration • Generating a USB key for Participants
2	Touch screen Section	<ul style="list-style-type: none"> • Consent • Touch screen questionnaire • Hearing Test • Cognitive function tests (Shape, Pairs, Fluid Intelligence, Snap)
3	Interview & blood pressure	<ul style="list-style-type: none"> • Interviewer questionnaire • Blood pressure measurement • Measurement of arterial stiffness (Pulse Wave Velocity)
4	Eye measurements	<ul style="list-style-type: none"> • Visual acuity • Auto-refraction • Intraocular pressure • Retinal image (OCT Scan)
5	Physical measurements	<ul style="list-style-type: none"> • Height (Standing and Sitting) • Hip & waist measurement • Weight and Bio-impedance (Body Composition) measurement • Hand-grip strength • Heel-bone ultrasound • Spirometry (Lung function Test)
6	Cardio (Physical fitness)	<ul style="list-style-type: none"> • Exercise ECG (Cycling)
7	Sample collection & exit	<ul style="list-style-type: none"> • Blood samples collected • Urine sample sought • Saliva sample sought • Consent & result summary printed • Travel expense claim provided
8	Web-based diet questionnaire	<ul style="list-style-type: none"> • Dietary assessment

1.2: Throughout this document, the term 'Participant' signifies a study participant who is taking part in the Assessment Centre process, regardless of whether they eventually give or withhold consent to take part in the UK Biobank study.

1.3: The collection of data from assessment visits uses the direct data entry system of the Assessment Centre Environment (ACE). This has five components (**Assessment Centre Environment**), of which Vox operates the Ocular station of the assessment visit.

1.4: At the start of their visit, each participant is issued with a USB Key at the Reception station. This USB Key acts as a participant identifier (it contains Participant ID, name, date of birth and gender) and as a temporary storage device for the recorded data. As the participant progresses between stations, the USB key acts as an identifying token and also as a data transfer mechanism. At the Reception & Exit module, all data on the USB key is removed, after it has been backed up to the Assessment Centre head PC.

2. Staff

Assessment centre technicians trained in this procedure are responsible for carrying it out. The Duty Manager oversees that all assessment centre staff work in accordance with the standard operating procedure.

3. Participant testing procedure

3.1: Optical Coherence Tomography is a non-invasive method of producing cross-sectional images of the retina. This can allow early detection of macular degeneration, glaucoma and optic nerve damage. The technique uses light reflected from 1-2 mm below the surface of the retina to build up a 3-dimensional image. Scattered light is filtered out so that the resulting image remains clear. Relatively long wavelengths of light (~100 nm) are used to allow penetration into the retina. The device used at the UK Biobank Assessment Centre is the TOPCON 3D OCT 1000 Mk2 (Topcon Corporation, Tokyo, Japan; figure 1). This instrument also provides a magnified photograph of the fundus, which can be used to identify arterial damage due to diabetes.

Figure 1: TOPCON 3D OCT 1000 Mk 2.



3.2: Before the testing session each day the dust cover is removed from the Topcon 3D OCT 1000 Mk2. The device is switched 'On' before switching the computer base unit on. It is checked that the chin rest has a plentiful supply of paper. The Duty Manager is responsible for checking the TOPCON 3D OCT 1000 MK2 lens to ensure it is clean and scratch-free, and keeps a record of this. Only if the lens is dirty it is cleaned using microfibre lens cleaning cloth by breathing on lens whilst unit is cold and wiping lens from centre out using circular motion (taking any artefacts to the outer edge). For stubborn marks lots of warm breaths are used, without scratching at lens or using cleaning solutions.

4. Optical Coherence Tomography Scan of Retina

4.1: Optical Coherence Tomography is the final test, after the **Visual Acuity, Refraction** and **Intra-Ocular Pressure** tests. The participant is seated in an enclosed dark room, free from sources of glare and conditioned to maintain the correct humidity and temperature for the efficient running of the eye measurement equipment. The participant's USB key remains in the computer, and Vox continues to operate following the previous tests at the station.

4.2: If the participant has had any eye surgery within the last 4 weeks they cannot have any Ocular measurements. Participants with possible eye infections do not undergo refraction, intra-ocular pressure or OCT measurements but may complete the Visual Acuity Measurement.

4.3: The measurement procedure is explained to the participant and they are informed that this test will take a 3D image and photograph of the back of their eye. The right eye will be photographed first, followed by the left eye. The participant is reassured that the device will move but will not touch the eye. They are reminded to remove glasses and contacts, if they have not already done so. Contact lens cases and solutions are provided for this purpose. If the participant does not wish to do this, the test is not performed and the reason is recorded.

4.4: On the Vox screen 'Measurable' is selected if image capture of the Right eye is possible. If retinal images cannot be captured the reason why this was not performed is selected (Equipment Failure or Other Reason. Other Reason can be either a reason from the drop down menu or free text entered in the blank window space).



4.5: The connection is now made between Vox and the TOPCON device, which has its own PC. On the Vox page below, 'Partner' is selected. This opens the pop up box 'Connection Partner'. The number is found on the TOPCON PC by double clicking on the Vox Partner icon, and entered. This procedure is carried out once at the start of each session only.



4.6: On the Vox page the 'Measure' button is selected. On the TOPCON PC, the TOPCON software starts automatically. The 'Capture Data' icon is selected to open up the participant registration page. From the participant registration page, the 'Register New Patient' bar is selected. This opens up a window (as shown below).

Register New Participant

Macula

The screenshot shows the UK Biobank software interface. At the top, there is a navigation bar with icons for 'Macula', 'Basal Ganglia', 'Anterior Segment', and 'Fundus Photo'. The 'Macula' icon is selected. Below the navigation bar, there is a 'Register New Patient' window. This window has a 'Patient Search' section on the left and a 'Register Patient' form on the right. The 'Register Patient' form has several sections: 'Basic Information' (ID: 1, Last Name: 1, Middle Name, First Name, Birth Date, Sex: Male), 'Regular Information' (Chart No., Entry Date: 13-11-2009, Entry Class, Occupation), 'Physicians' (four dropdown menus), 'Diagnosis' (four dropdown menus), 'Image Notes' (text area), 'Custom Fields' (three dropdown menus), and 'Comment' (text area). At the bottom right of the form, there are buttons for 'Register' and 'Cancel'. The 'Register' button is highlighted.

4.7: The participant details are completed by entering the number 1 under both the ID and last name fields. Then the 'Register' button is clicked. This procedure is used to register each participant. No participant identifiable information is ever entered onto the TOPCON PC.

Note: Only the ID and Last Name fields need to be completed.

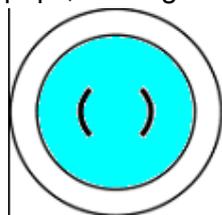
4.8: The room lights are dimmed. The lighting conditions in the room are kept as low as possible, while compatible with safe movement around other equipment. The Macula Icon is selected (as shown above). The lens cover is removed.

4.9: The participant is positioned using the height-adjustable table to allow the participant to be sat up straight with his/her chin placed centrally on the chinrest and with their forehead against the forehead rest. It is checked that the participant's eyes are level with the Canthus marker of the headrest post (figure 2). Chinrest height is further adjusted using the chinrest ↑ and ↓ switch located on the control panel.

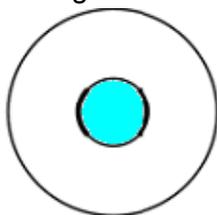
Figure 2: Participant's eye in correct position

4.10: The instrument body is positioned close to the operator and towards the L or R side (according to which eye is being scanned) in order to visualise the eye. It is checked that the TOPCON screen correctly displays the side being scanned (by showing the letter L or R on the display screen).

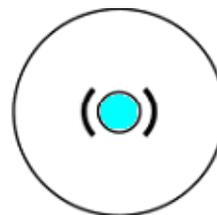
4.11: On the TOPCON display screen, the () markers are brought to the external rim on the pupil, making sure that the pupil is larger than the () markers.



Well dilated



Narrowly dilated



Small pupil

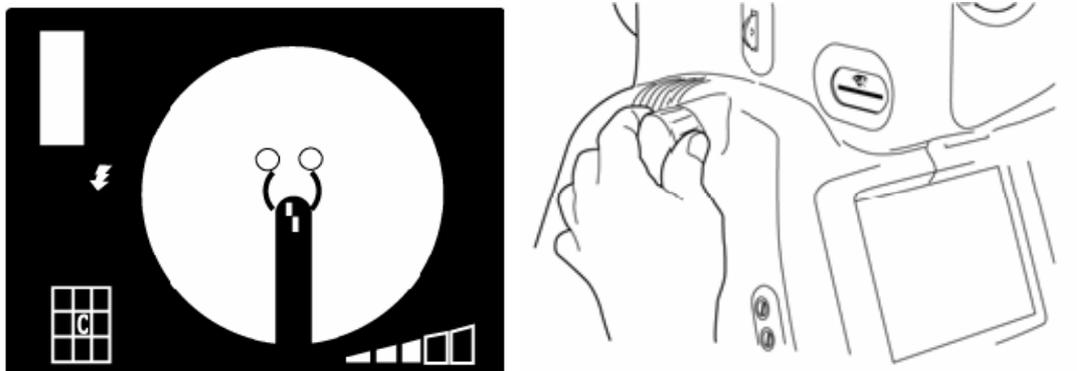
Comparison of the () scale and the eye reveals whether the pupil is large enough for retinal photography. If the pupil is small the room is darkened further and the patient asked to blink a few times or shut their eyes for a while. If a repeat image must be taken, some time may be needed for the pupils to recover from the flash.

4.12: The technician takes care to avoid injury to the participant's eye and nose while moving the instrument body, by observing the distance between the participant and the objective lens. With the omni-directional joystick in an upright position the instrument body is gently pushed towards the participant. As the internal fixation target turns on, the patient is instructed to look at the fixation target in the centre of the screen. This is seen as a green cross. The participant is asked to keep their gaze fixed on the centre of the cross.

4.13: The instrument is brought still closer to the participant until two bright spots for the working distance alignment become visible. Using the wheel of the joystick, the two bright spots are brought level with () markers. Then the base unit is pushed forwards slightly so

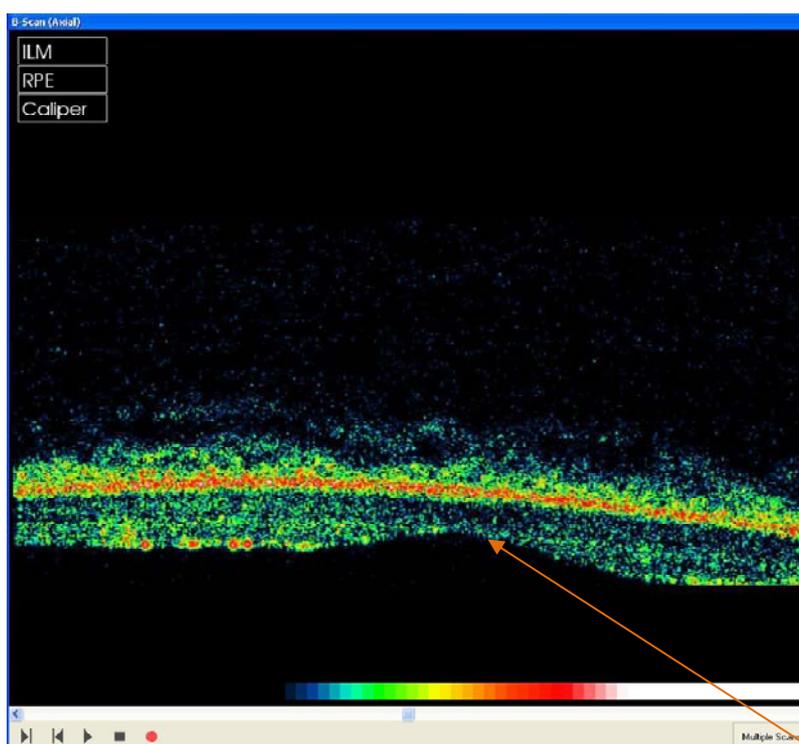
that they merge together into one spot. This single spot is ideally placed within the () markers.

Figure 3: Bringing the two bright spots together (left), and aligning the two white split lines (right).

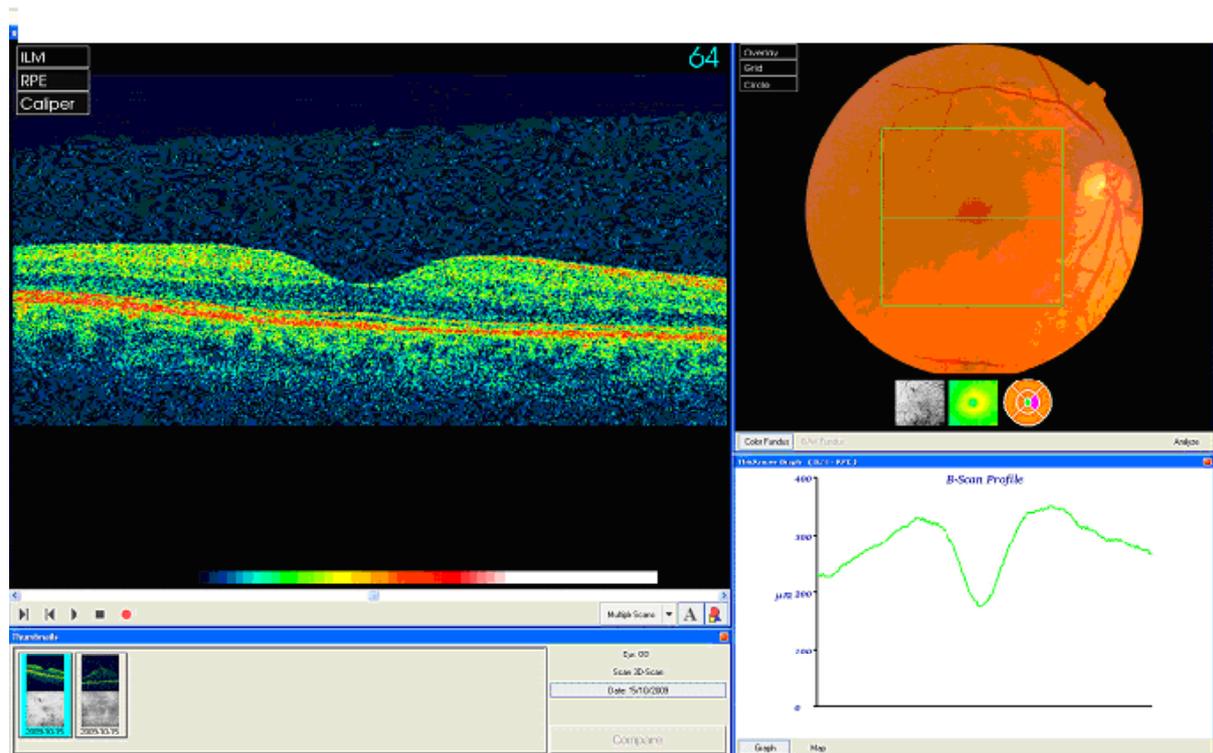


4.14: The focussing dial is turned to align the two white split lines into one line.

If the OCT image appears too low, grainy or appears inverted on the TOPCON screen, the 'AZ' button is pressed to correct this before capturing the retinal images. An inverted image shows the foveal dip on the underside image (below)

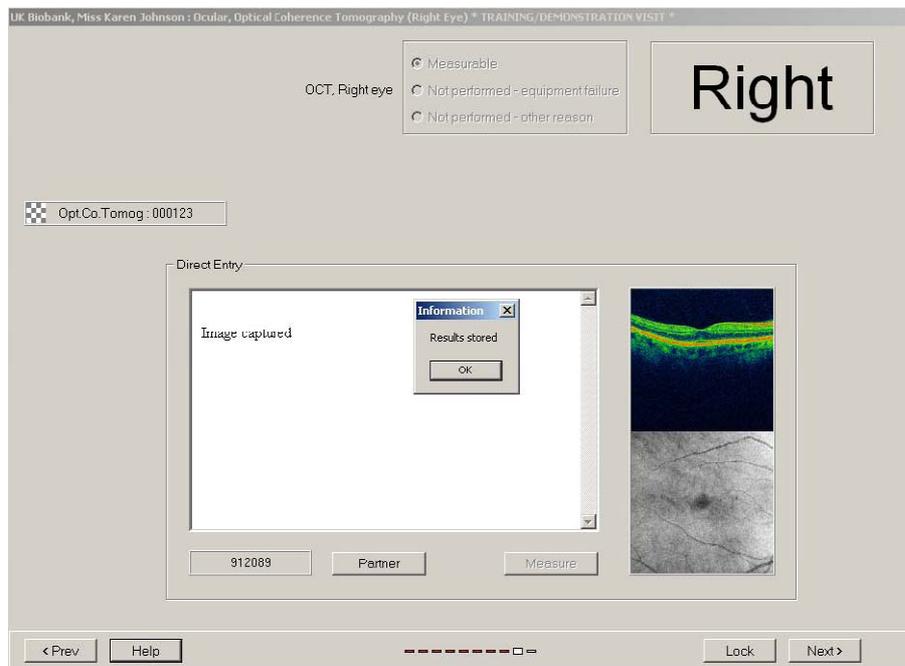


4.15: The participant is instructed to focus on the green cross and they are asked to 'blink, blink, keep both eyes open,' the image on the screen is checked, then the button on top of the joystick is pressed to capture the retinal images. On the display screen, the OCT image and retinal photograph should be well centred and in focus. The pixels on the OCT image appear evenly bright and not "grainy" (similar to the image below).



4.16: If the image or retinal photograph are not acceptable, the measurement is re-taken by selecting the 'Live' icon and repeating as above. The best image is saved by clicking on the 'Save' button.

4.17: The TOPCON programme is exited by clicking on the X (Close Window button top right of the screen). The image data is transported to the ACE system, taking up to 1 minute. 'OK' is clicked when the 'Results stored' message appears on the VOX screen.



4.18: The process is repeated for left eye image capture, with number 1 re-entered for the participant identifiers on TOPCON 'Register New Patient' screen.

4.19: The lens cover is replaced immediately following completion of image capture. The participant is thanked, their glasses/contacts and USB key are returned, and they are directed to the **Physical Measurements** station. The headrest is cleaned with Azowipes and the chin rest papers are replaced.

4.20: At the end of the session the lens cover and dustcovers are replaced. After the last participant has left the eye station, the 'Archive' button is pressed on the VOX program to download the data onto a USB key which is inserted into the ACE computer.

4.21: The following morning when all the previous session's data has been downloaded the USB key is couriered to the UK Biobank Coordinating Centre in a secure pouch.