OPHTHALMOLOGY CLINICS-2

for Postgraduates

Basic Sciences
Instruments
Investigations
Imaging
Interpretation & Viva Voice

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SECTION 1 Appliances and Instruments

10 CHAPTER

Interpretation of Images

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INTERPRETATION OF GOLDMANN VISUAL FIELDS

General Principles

Look for following while interpreting a Goldmann visual field (GVF). The report should be interpreted under following headings:

- Eye involved
- Size of stimulus used. The various size of stimulus used have been summarized in Table 10.1
- The area involved general or local
- *The density of scotoma:*
  - *Absolute*: No visual sensation perceived
  - *Relative*: Depressed visual sensation perceived.
- *The position of field defect:*
  - Central, temporal, nasal, superior, and inferior.
- *Shape*:
  - Sectoral (hemianopia)
  - Non-sectoral (regular or irregular).
- Differential diagnosis of conditions in which the given filed defect is found.

Table 10.1: Various stimuli size, diameter, and area used in Goldmann visual fields.

Size of stimulus	*Diameter in mm*	*Area in mm²*
0	0.28	1/16
I	0.56	1/4
II	1.13	1
III	2.26	4
IV	4.51	16
V	9.03	64

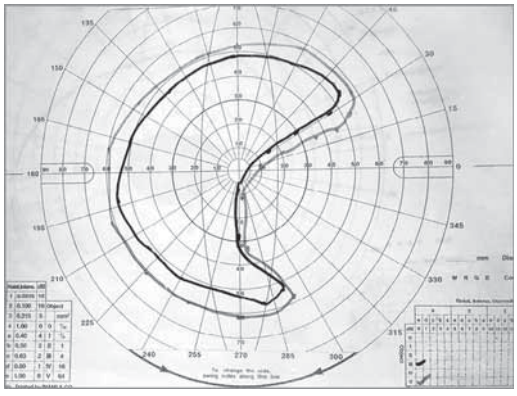


Fig. 10.1: Goldmann visual field (GVF) showing right inferior quadrantanopia.

Specific Examples

- *Example 1 (Fig. 10.1):*
  - The given GVF is of the right eye and has been plotted using a stimulus size of IIIe0 and Ve0.
  - The field shows a depressed response in the inferonasal quadrant suggestive of inferior quadrantanopia.
  - Differential diagnosis of inferior quadrantanopic field defects includes:
    - Neoplasia

- Infarction
- Infections involving occipital lobe.

- *Example 2 (Fig. 10.2):*
  - The given GVF is of the right eye and has been plotted using a stimulus size of I4e0, V4e0, and I3e5.
  - The field shows a dense central scotoma
  - Differential diagnosis of this defect includes:
    - Optic neuritis
    - Hereditary optic neuropathy (bilateral central scotoma will be present)
    - Toxoplasma scar
    - Neurosensory detachment as in central serous choroidopathy

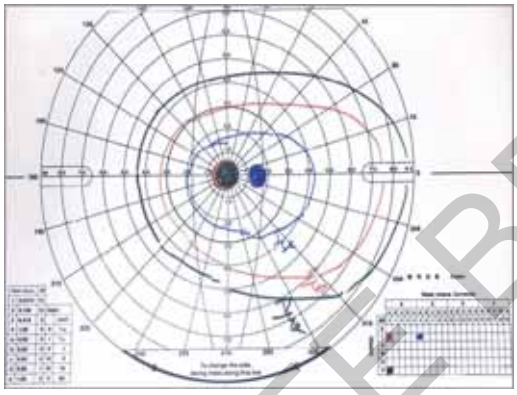
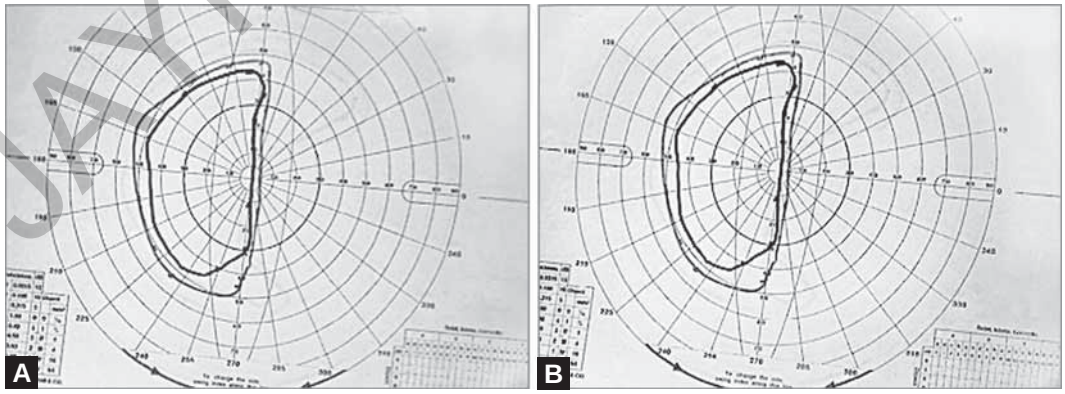


Fig. 10.2: Goldmann visual field showing right central scotoma.

- Macular edema
- Macular degeneration.

- *Example 3 (Figs. 10.3A and B):*
  - The given GVF shows a depressed response in the nasal quadrant of the right eye and a depressed response in the temporal quadrant of the left eye.
  - This is suggestive of right eye homonymous hemianopic field defect.
  - *Differential diagnosis of these defects include*:
    - Retrochiasmal lesions
    - Alzheimer's disease
    - Cortical basal ganglion degeneration
    - Mitochondrial encephalomyopathy
    - Neurosyphilis
    - Neuromyelitis optica
    - Posterior cerebral artery occlusion
    - Epilepsy.
- *Example 4 (Fig. 10.4):*
  - The given GVF is of the left eye and has been plotted using a stimulus size of V4e0
  - The field shows a dense scotoma involving the center and area surrounding it, suggestive of centrocecal scotoma
  - *Differential diagnosis of this defect includes*:
    - Optic neuritis



Figs. 10.3A and B: Goldmann visual field showing right homonymous hemianopia.

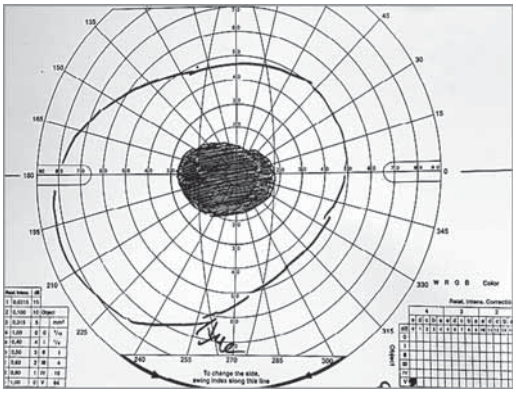


Fig. 10.4: Goldmann visual field showing left centrocecal scotoma.

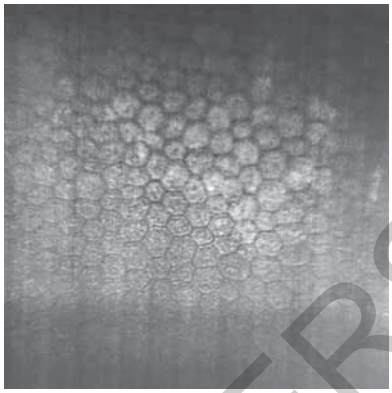


Fig. 10.5: Normal corneal endothelial cell.

- Toxic optic neuropathy
- Stargardt disease.

INTERPRETATION OF SPECULAR MICROSCOPY

General Principles

Look for following while interpreting specular microscope images. The interpretation should be made under the following headings as mentioned below:

- Endothelial cell shape
- Endothelial cell morphology
- Presence of cell dropout or guttae
- Differential diagnosis.

Specific Examples

- *Example 1 (Fig. 10.5):*
  - This is specular microscope image showing:
    - Hexagonal endothelial cells
    - Cells have a bright center and dark border
    - Some variability in the cell size is visible (polymegathism)
    - No cell dropout or guttae.
  - This appears to be a normal scan showing normal endothelial cells.

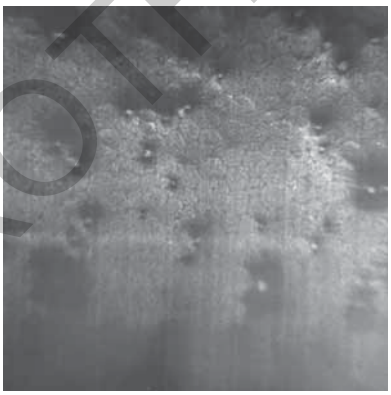


Fig. 10.6: Corneal guttae.

- *Example 2 (Fig. 10.6):*
  - This is a specular microscope image showing:
    - Few hexagonal endothelial cells
    - Corneal guttae are present that are visible as dark areas
    - Few intervening endothelial cells between the corneal guttae have abnormal shape with missing cell boundaries.
  - This image suggests the presence of corneal guttae, which can be seen in various conditions like Fuchs' endothelial corneal dystrophy, glaucoma, uveitis, and old age.

- *Example 3 (Fig. 10.7):* This is a specular microscope image showing:
  - Endothelial cells of variable shape (pleomorphism) and size (polymegathism)
  - The cells have a dark area with a light central spot
  - A light peripheral zone is visible with a dark border.

All the above findings suggest that this is a specular microscopy image of a case with iridocorneal endothelial syndrome. The typical appearance of this endothelial cell is called "iridocorneal-endothelial (ICE) cell."

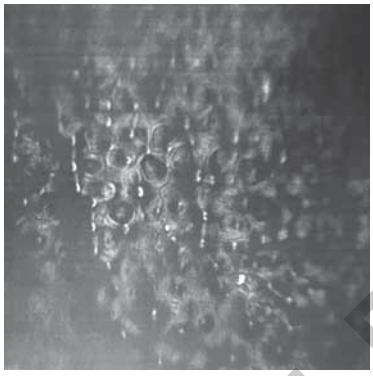


Fig. 10.7: Iridocorneal-endothelial (ICE) cells.

INTERPRETATION OF PENTACAM

General Principles

Look for the following while interpreting a Pentacam map. The interpretation should be made under the following headings as mentioned below. The normal values, as well as screening criteria for diagnosing keratoconus, must be remembered before going through this section (refer the chapter on Pentacam).

- Type of map
- Eye involved
- Age of patient
- K mean
- K_{max}
- Pachymetry apex
- Thinnest pachymetry
- Anterior elevation
- Posterior elevation
- Differential diagnosis.

Specific Examples

- *Example 1 (Fig. 10.8):*
  - This is a Pentacam map showing:

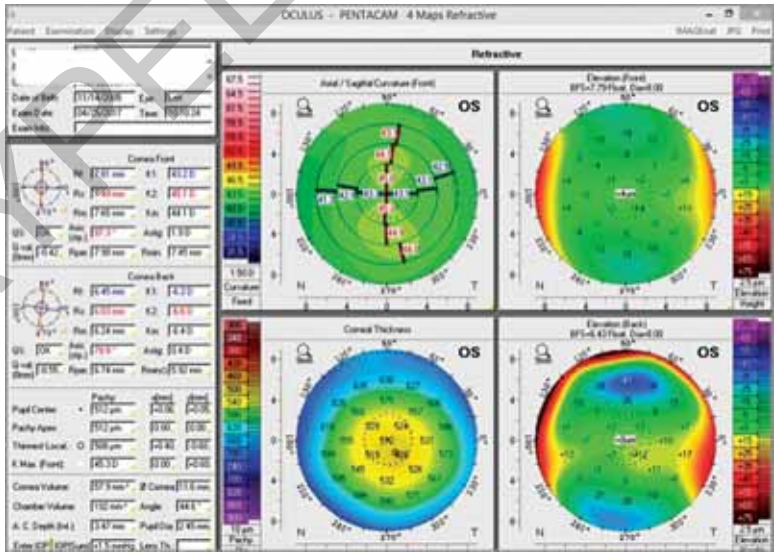
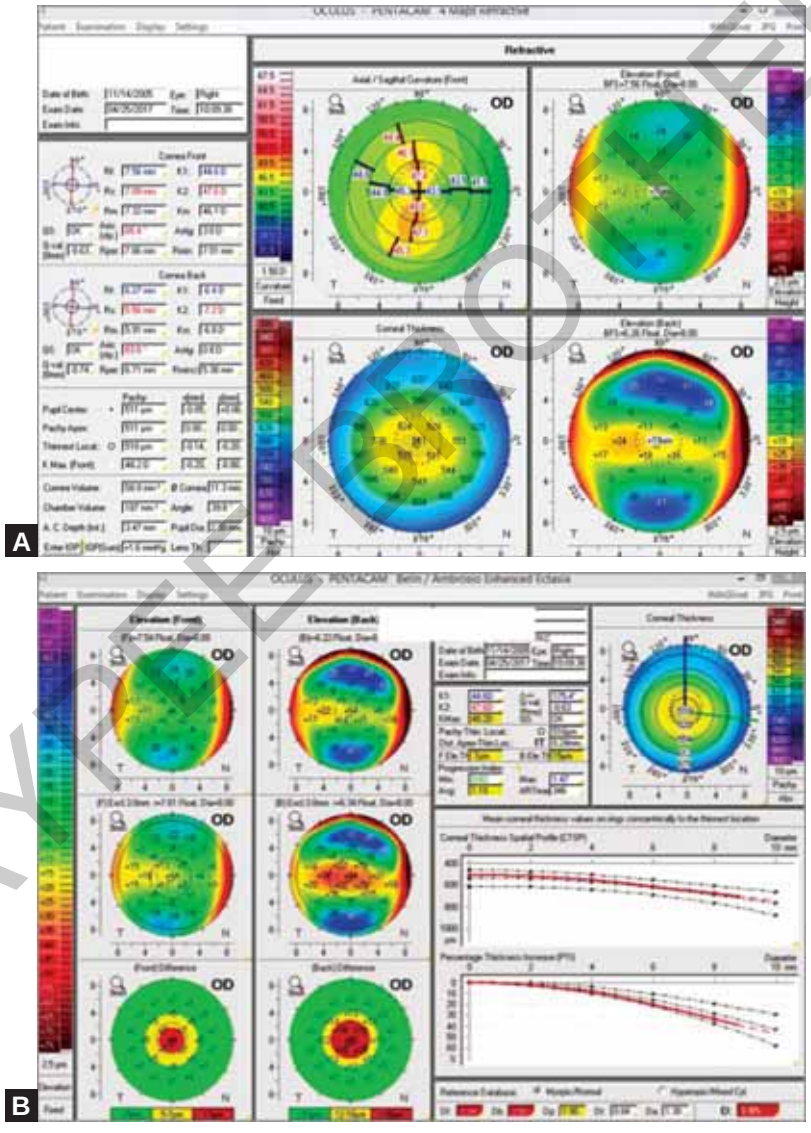


Fig. 10.8: A normal cornea.

- Four maps refractive display
- The left eye
- A 12-year-old patient
- A mean keratometry of 44.1 D
- K_{max} of 45.3 D
- Pachymetry apex of 512 µm
- Thinnest pachymetry of 508 µm
- Anterior elevation 4 µm
- Posterior elevation 12 µm.

  - This appears to be a normal scan showing with the rule corneal astigmatism.

- *Example 2 (Figs. 10.9A and B):*
  - This is Pentacam map showing:
    - Four maps refractive display
    - Right eye
    - A 12-year-old patient



Figs. 10.9A and B: (A) Four maps refractive display of forme fruste keratoconus (FFKC); (B) Belin/Ambrósio enhanced ectasia display showing FFKC.

- A mean keratometry 46.1 D
- K_{max} of 48.2 D
- Pachymetry apex of 511 μm
- Thinnest pachymetry of 510 μm
- Anterior elevation 7 μm
- Posterior elevation 24 μm (abnormal).

◆ This scan shows with the rule corneal astigmatism that appears suspicious for forme fruste keratoconus (FFKC) based on the increased posterior elevation. Hence, I would like to evaluate the Belin/Ambrósio enhanced ectasia display of this patient.

◆ This is a Pentacam map showing:
- Belin/Ambrósio enhanced ectasia display
- The right eye
- A 12-year-old patient
- K_{max} of 48.2 D
- Thinnest pachymetry of 510 μm
- Inferotemporal displacement of the thinnest location by 0.24 mm (normal range)
- Posterior elevation 22 μm (abnormal)
- Posterior elevation on enhanced ectasia map 34 μm (abnormal)
- Both front and back difference map is abnormal (in red)
- Corneal thickness spatial profile is normal
- Percentage thickness increase is abnormal (curve touching the lower border in the 6 mm zone)
- D value is 3.05 (abnormal).

◆ Hence this is a case of FFKC.

■ *Example 3 (Figs. 10.10A and B):*

◆ This is Pentacam map showing:
- Four maps refractive display
- The right eye
- A 34-year-old patient
- A mean keratometry 49.1 D
- K_{max} of 54.9 D
- The axial curvature map shows inferior steepening
- Pachymetry apex of 423 μm
- Thinnest pachymetry of 410 μm
- Pachymetry map shows the inferotemporal displacement of the thinnest location on the y-axis by 0.63 mm (suspicious)
- Anterior elevation 33 μm (abnormal)
- Posterior elevation 67 μm (abnormal)

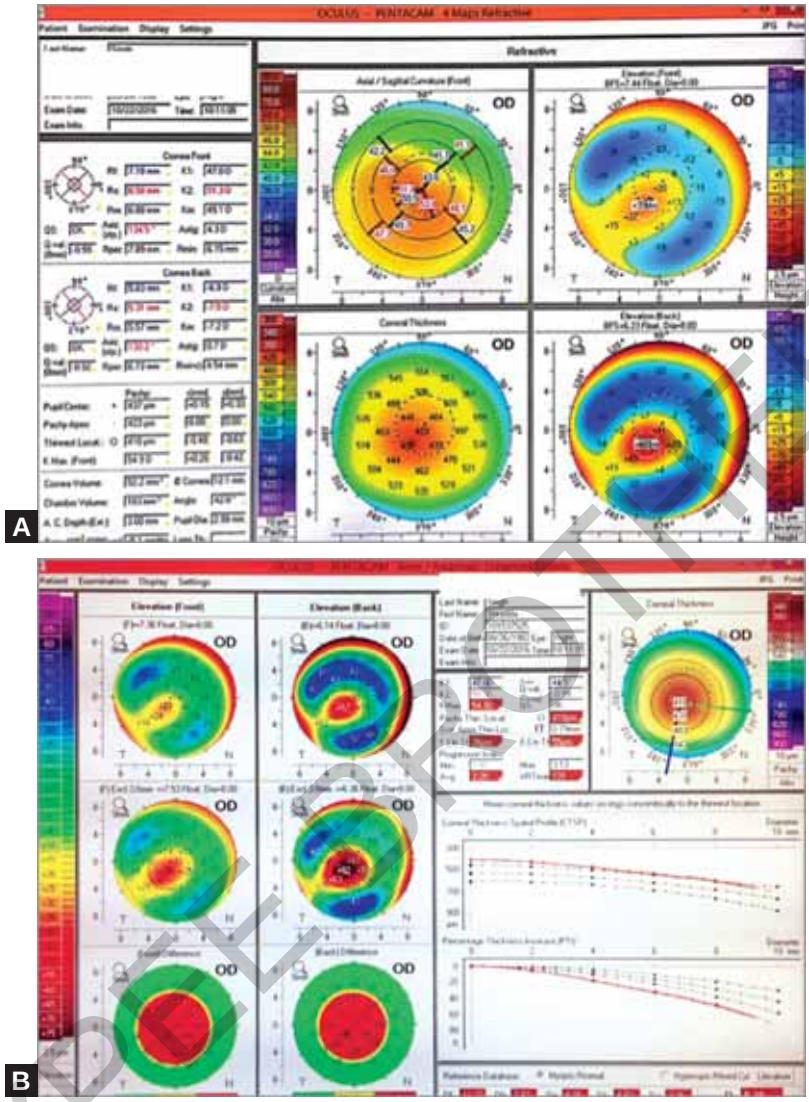
◆ This scan suggests that it is a case of keratoconus as the area of corneal thinning is corresponding with the area of corneal ectasia.

◆ This is a Pentacam map showing:
- Belin/Ambrósio enhanced ectasia display
- The right eye
- A 34-year-old patient
- K_{max} of 54.9 D
- Thinnest pachymetry of 410 μm
- Inferotemporal displacement of the thinnest location by 0.24 mm (normal range)
- Posterior elevation 37 μm (abnormal)
- Posterior elevation on enhanced ectasia map 82 μm (abnormal)
- Both front and back difference map is abnormal (in red)
- Corneal thickness spatial profile is abnormal (curve outside the normal range with a sudden dip at 4 mm zone)
- Percentage thickness increase is abnormal (curve outside the normal range)
- D value is 9.36 (abnormal).

◆ Hence this is a case of keratoconus.

■ *Example 4 (Fig. 10.11):*

◆ This is a Pentacam map showing:
- Four maps refractive display
- The left eye



Figs. 10.10A and B: (A) Four maps refractive display; (B) Belin/Ambrósio enhanced ectasia display.

- A 37-year-old patient
- A mean keratometry 43.9 D
- K_{max} of 50.6 D
- The axial curvature map shows superior flat corneal contour with an inferior band of corneal steepening in the pattern of "crab claw" or "kissing doves"
- Pachymetry apex of 495 µm
- Thinnest pachymetry of 480 µm
- Pachymetry map shows inferotemporal displacement of the thinnest location on y-axis by 1.12 mm (suspicious)
- Anterior elevation 43 µm (abnormal)
- Posterior elevation 61 µm (abnormal).

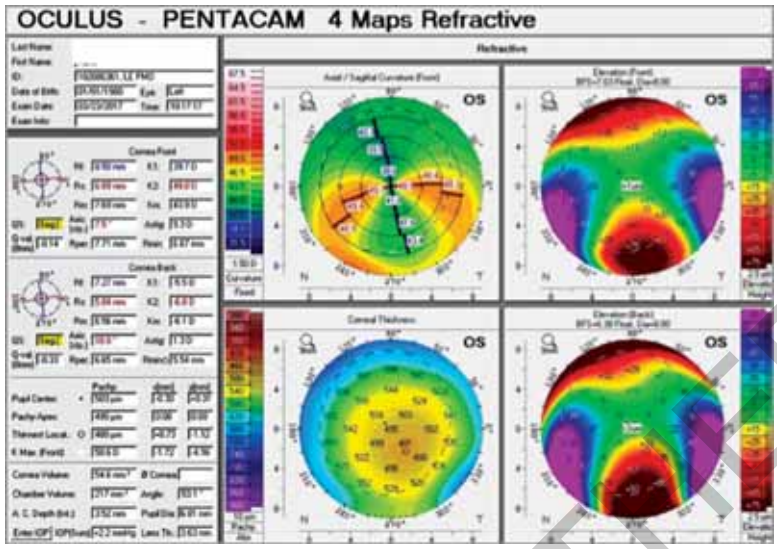


Fig. 10.11: Four maps refractive display showing pellucid marginal corneal degeneration (PMCD).

- This scan suggests a diagnosis of an ectatic corneal disorder, likely pellucid marginal corneal degeneration because the area of maximum corneal ectasia is superior to the area of corneal thinning and the typical "crab claw" appearance on the axial curvature map.

INTERPRETATION OF HUMPHREY VISUAL FIELD

Specific Examples

- *Example 1*—Steps to Interpret (Fig. 10.12A):
  - *Step 1:* This is a single field analysis of right eye of a 61 years old patient.
  - *Step 2:* By using central 30-2, Swedish Interactive Threshold Algorithm (SITA)-fast strategy with appropriate near correction given.
  - *Step 3:* The visual field is reliable.
  - *Step 4:* Total deviation probability plot shows scotoma or defect in the superior half area.
  - *Step 5:* Pattern deviation probability plot also shows a similar defect indicating localized damage, suggestive of superior arcuate going into the periphery.
  - *Step 6:* Global indices are abnormal (Visual field index (VFI) 71%, Mean deviation (MD) –10.83 dB, and Pattern standard deviation (PSD) 15.65 dB).
  - *Step 7:* Glaucoma Hemifield test is outside normal limits.
  - *Step 8:* Anderson's criteria will be met with if these defects are reproducible on consecutive visual fields. Therefore, given visual field shows a superior arcuate scotoma breaking into the periphery, suggestive of glaucomatous damage. Clinical correlation is needed.
- *Example* 2 *(Fig. 10.12B):*
  - *Step 1:* Single field analysis of the right eye of a 56 years old patient.
  - *Step 2:* By using central 30-2, SITA-Fast strategy with appropriate near correction given.

- *Step 3:* The visual field is reliable.
- *Step 4:* Total deviation probability plot shows scotoma or defect in nasal area inferiorly.
- *Step 5:* Pattern deviation probability plot also shows a similar defect indicating localized damage. Global indices are abnormal (VFI 94%, MD 2.75 dB and PAD 7.63 dB).
- *Step 6:* Glaucoma Hemifield test is outside normal limit.
- *Step 7:* Anderson's criteria will be met with if these defects are reproducible on consecutive visual fields. Therefore, given visual field shows an inferior nasal step, suggestive of glaucomatous damage. Clinical correlation is needed.

- *Example 3 (Fig. 10. 12C):*
  - *Step 1:* Single field analysis of the right eye of a 55 years old patient.
  - *Step 2:* By using central 30-2, FASTPAC strategy with appropriate near correction.
  - *Step 3:* The visual field is reliable.
  - *Step 4:* Total deviation probability plot shows superior and inferior arcuate scotoma, breaking into the periphery.
  - *Step 5:* Pattern deviation probability plot also shows a similar defect indicating localized damage.
  - *Step 6:* Global indices are abnormal (MD-26.15, PSD 7.72).
  - *Step 7:* Anderson's criteria will be met with if these defects are reproducible on consecutive visual fields. Therefore, given visual field shows a double arcuate scotoma breaking into the periphery, suggestive of advanced glaucomatous damage. Clinical correlation is needed.
- *Example 4 (Fig. 10.12 D):*
  - *Step 1:* Single field analysis of left eye of a 49 years old patient.
  - *Step 2:* By using central 30-2, SITA-Fast strategy with appropriate near correction given.
  - *Step 3:* The visual field is reliable.
  - *Step 4:* Total deviation probability plot shows generalized depression which is not present in pattern deviation probability plot, suggestive of a nonglaucomatous defect like cataract. Clinical correlation is needed.
- *Example 5 (Fig. 10.13):*
  - *Step 1:* Guided progression analysis (GPA) report of the left eye of a patient named, ...
  - *Step 2:* The upper two fields depict the baseline fields of the patient on presentation showing VFI 96%, MD –4.13 dB, and PSD 3.10 dB.
  - *Step 3:* Below that is the VFI plot with a steeper slope, showing significant progression based on VFI values. It also shows that this much amount of 3–5 years progression is going to happen in future, if the current trend follows.
  - *Step 4:* The rate of progression is –3.0± 0.9%/year.
  - *Step 5:* Below that is the current visual field summary showing VFI 73%, MD –13.67 dB, and PSD 6.55 dB. GPA alert shows "likely progression."

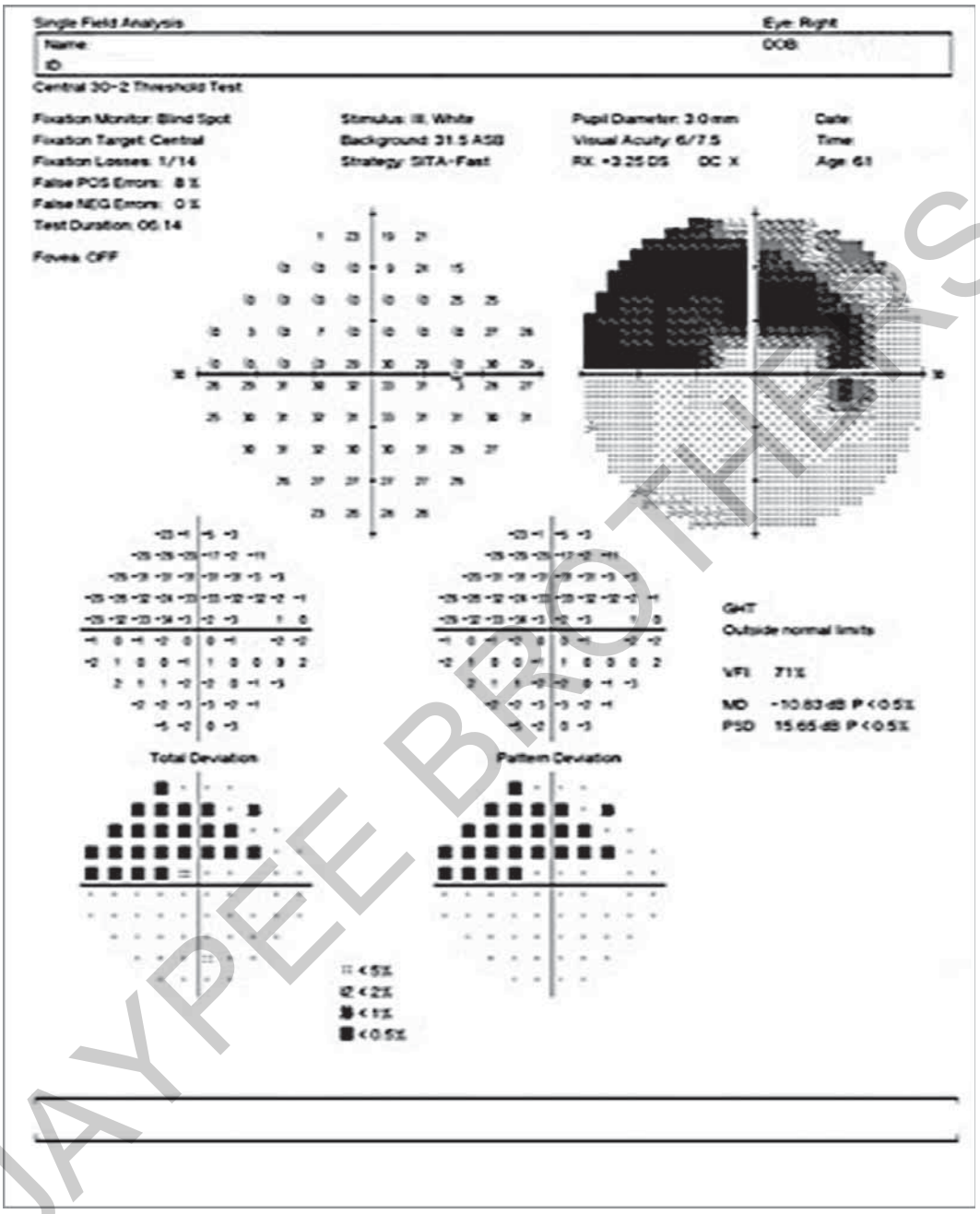


Fig. 10.12A

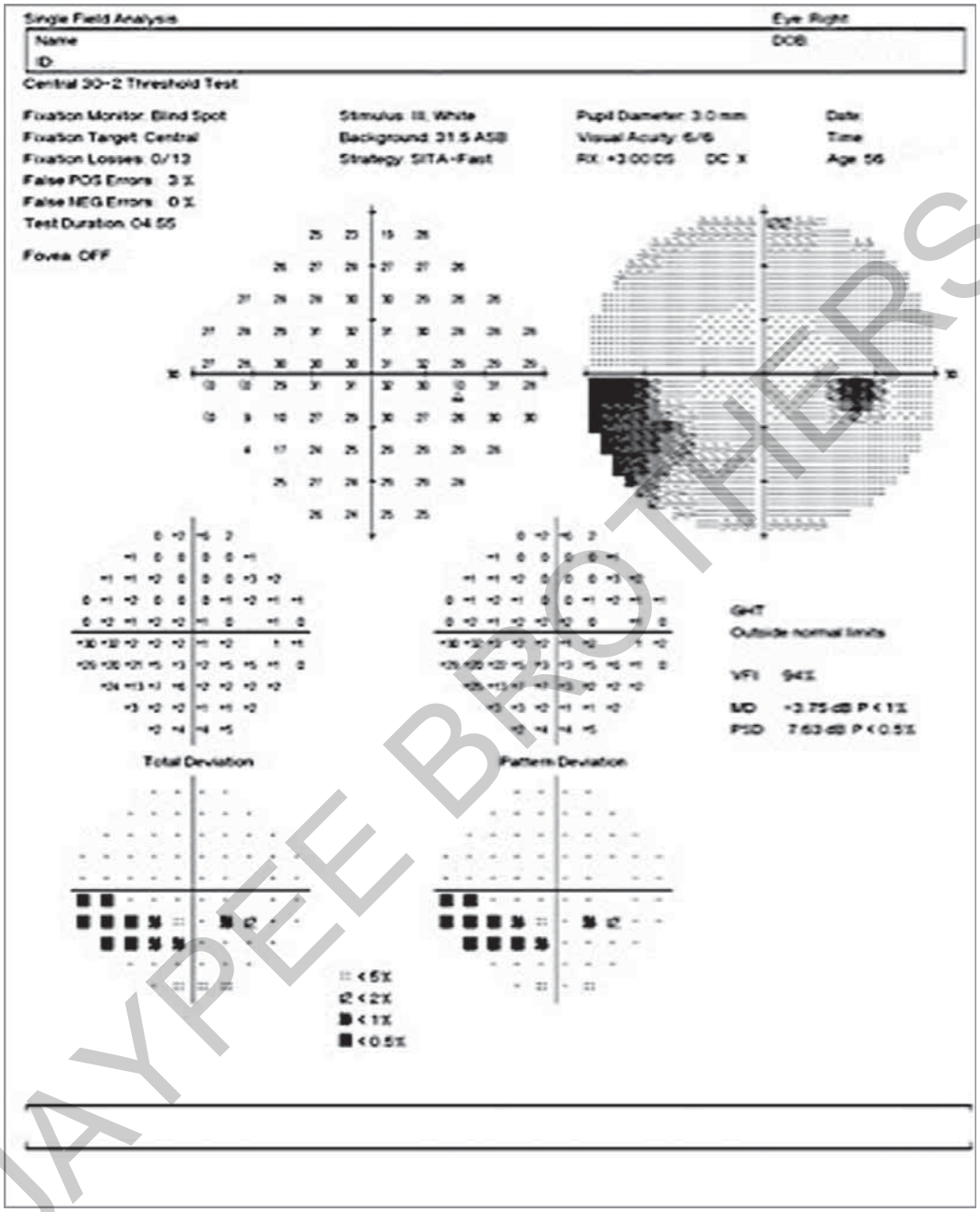


Fig.10.12B

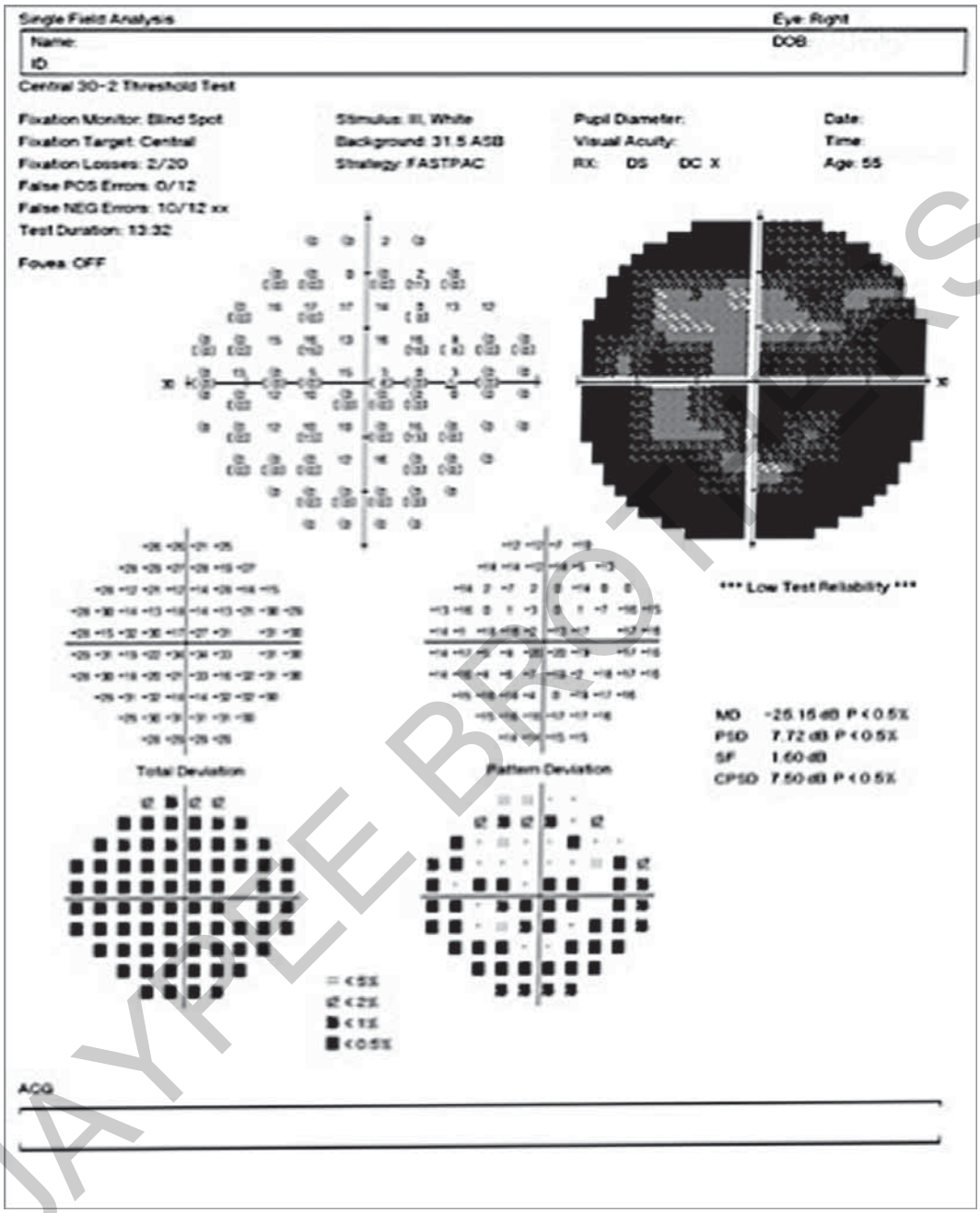


Fig. 10.12C

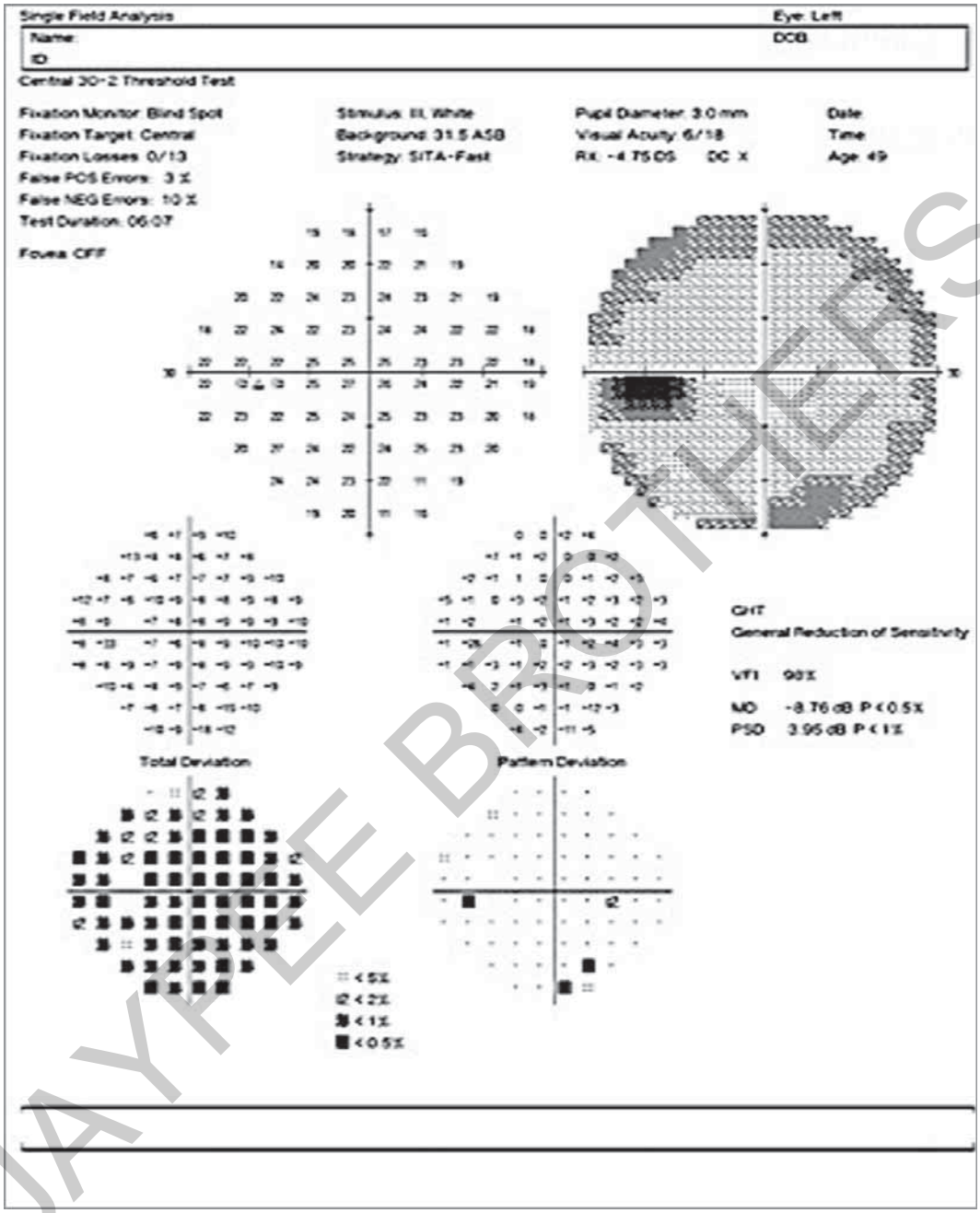


Fig. 10.12D

Figs. 10.12A to D: Humphrey visual field.

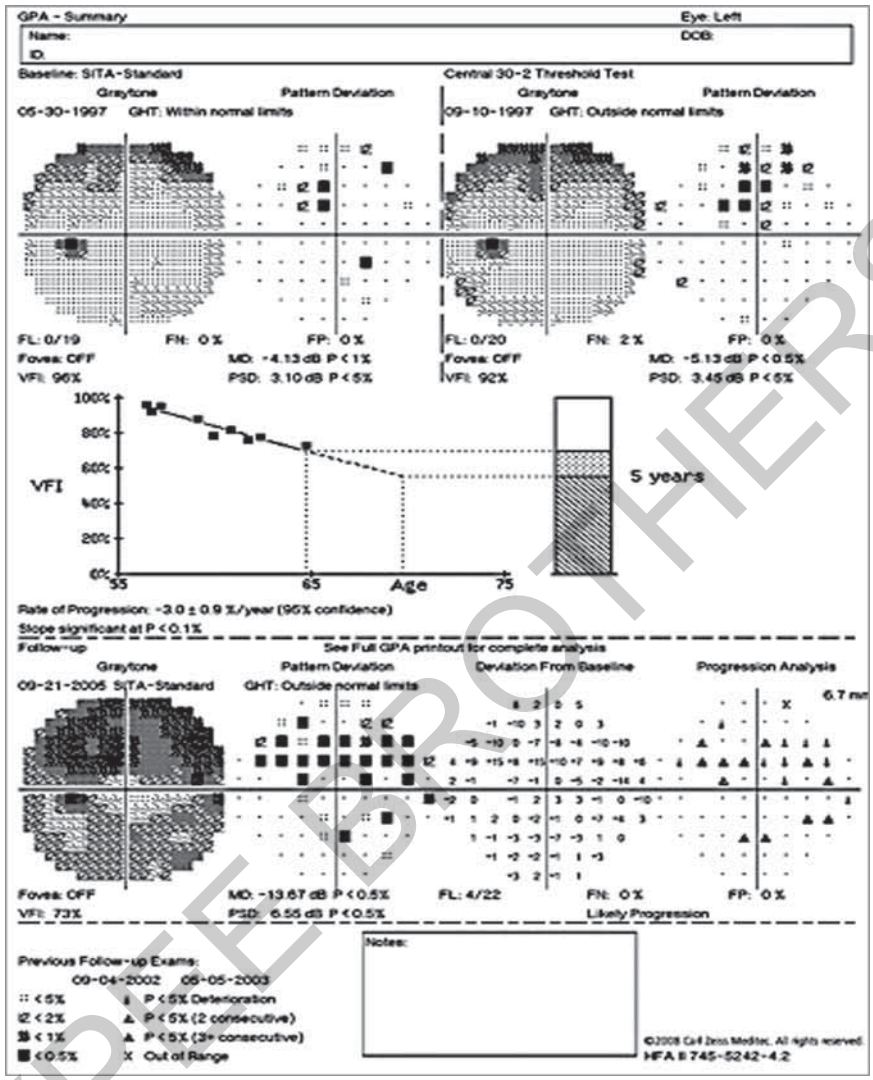


Fig. 10.13: Guided progression analysis.

INTERPRETATION OF ANTERIOR SEGMENT OPTICAL COHERENCE TOMOGRAPHY

Specific Examples

- *Example 1 (Fig. 10.14):* This is an anterior segment optical coherence tomography (ASOCT) image showing Descemet membrane detachment with a corneal thickness of 571 μm.
- *Example 2 (Fig. 10.15):* This is an ASOCT image of a case of operated endothelial keratoplasty. The total corneal thickness is 421 μm, and the thickness of donor corneal lenticule is 56 μm. The patient most likely seems to have undergone an ultrathin Descemet stripping automated endothelial keratoplasty (DSAEK) considering the graft thickness and the smooth interface.
- *Example 3 (Fig. 10.16):* This is an ASOCT image of a case of operated phakic intraocular lens (IOL). The vault, in this case, is 620 μm.

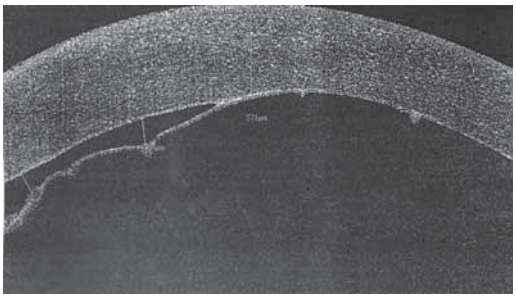


Fig. 10.14: Anterior segment optical coherence tomography (ASOCT) image showing Descemet membrane detachment.

Fig. 10.15: Anterior segment optical coherence tomography image of a case of operated endothelial keratoplasty.

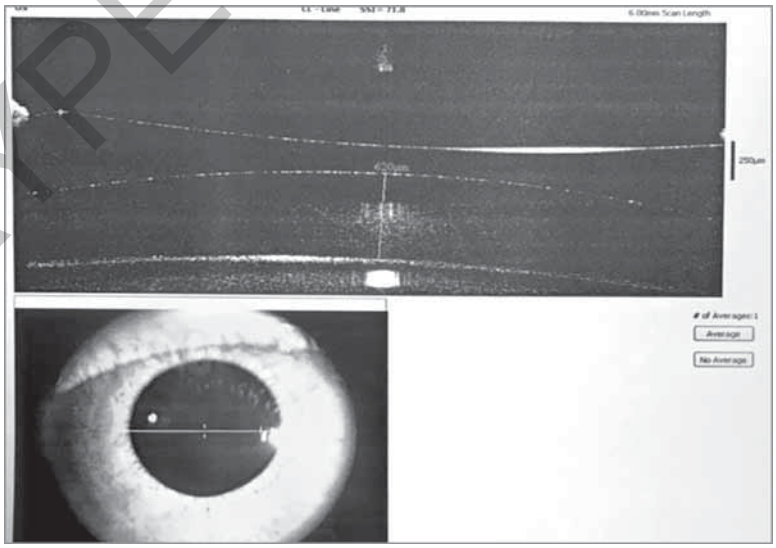


Fig. 10.16: Anterior segment optical coherence tomography image of a case of operated phakic intraocular lens.

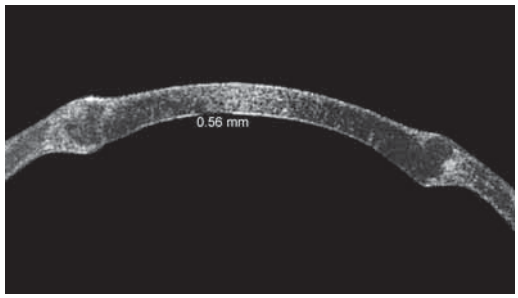


Fig. 10.17: Anterior segment optical coherence tomography image of a case of operated penetrating keratoplasty.

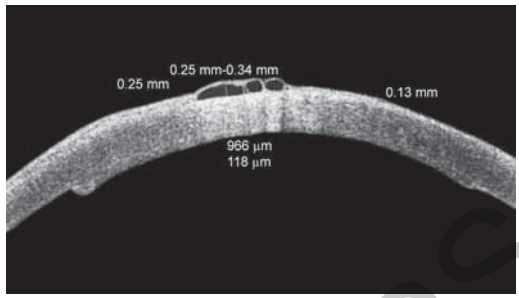


Fig. 10.18: Anterior segment optical coherence tomography image of a case of operated endothelial keratoplasty.

- *Example 4 (Fig. 10.17):* This is an ASOCT image of a case of operated penetrating keratoplasty. The graft thickness is 560 µm. The image shows an irregular contour of the posterior graft-host junction.
- *Example 5 (Fig. 10.18):* This is an ASOCT image of a case of operated endothelial keratoplasty. The total corneal thickness is 966 µm, and the thickness of donor corneal lenticule is 118 µm. Corneal epithelial bullae are visible. On the basis of the presence of epithelial bullae with increased corneal thickness, this appears to be a case of failed endothelial keratoplasty.

OPHTHALMOLOGY CLINICS-2
for Postgraduates

This book describes the different investigative tools in ophthalmology, their output, and how to interpret those findings with maximum possible images. It will help the students appearing in examination as well as the general practitioners to interpret the various investigative tools in ophthalmology and arrive at a diagnosis. The section on Appiliances and Instruments will help in appearing for viva-voce examination. The section on Basic Sciences such as, ocular microbiology, pathology basics, and community ophthalmology will help students appearing in various postgraduate examinations.

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