Visual Acuity:

- Visual acuity is recorded as chart distance (numerator) over the number of lowest line read (denominator).

**What does 6/12 mean?**

- Means what the pt sees at 6 meters, is what a normal person sees at 12 meters.
- If you bring the patient closer to 3 meters from the chart and then he finally sees the biggest row -> his vision is recorded as 3/60.

- You can add +1/-1 if the patient can/can’t see one letter of the next smaller/previous larger row.
- **What does +1 means?** The patient can see only one letter in the next smaller line.
- **What does -1 means?** The patient can’t see only one letter in that same line.
  - If the pt gets more than 2 letters wrong, then the previous line should be recorded as their acuity.

- **If the patient can’t see** -> try using a pinhole; if it improves, it suggests a refractive error.
- **If can’t read the top line at 6 m** -> reduce the distance to 5, 4, 3, 2, 1 m -> counting fingers (at 70, 50, 30 cm) -> hand motion -> light perception (by dimming the room).
  - If can’t see; say “no light perception” (avoid saying the patient is blind).
- **If the patient can see hand motion** -> do light projection in quadrantes (only if the patient can see hand motion), and record as either hand motion with good/poor projection.

**Optic Atrophy in the Right Eye** and you:

- Shine a light on the **right eye** -> **no direct reflex in the right + no consensual reflex in the left**
- Shine a light on the **left eye** -> **direct reflex in the left + consensual reflex in the right**

When doing the pupillary reflex, come with the light temporally, why? Bc if you shine the light straight -> this is the **Near reflex**: (1) pupillary constriction, (2) accommodation, (3) convergence.
INTRAOCULAR PRESSURE

How to measure intraocular pressure? Via two principles:

1. **Indentation**: “a force or a weight will indent or sink into a soft eye further than into a hard eye”
   - Digital/manual palpation: soft, firm, hard
   - Tono-pen
   - Schiotz tonometer

2. **Applanation**: by flattening the cornea
   - Goldmann tonometry
   - Air puff tonometer

CATARACTS:

- **MCC**: senile, pre-senile (DM), some diseases and medications (steroids)
- **Degree of visual acuity loss depends on**:
  1. **Location**: cortical (peripheral) < nuclear < posterior subcapsular (steroids)
  2. **Density**: mild < moderate < severe

- If the patient has **mature cataract** (the last and worst stage) their visual acuity will be: **hand motion with good light projection**
  - How does this matter? Bc if the pt with mature cataract and has vision less than hand motion w/ good light projection -> suspect another pathology which won’t be corrected by cataract surgery (e.g. DM retinopathy, macular degeneration, optic atrophy, retinal detachment)

  If a patient sustained **blunt trauma** (which can cause both mature cataract (quickly) and retinal detachment) with visual acuity less than hand motion w/ good projection, how do we confirm if the cause of severe drop in visual acuity is secondary to retinal detachment (since we can’t simply look through a fundoscope bc no clear media due to the cataract)?
    - **Pupillary reflex** (unlike cataracts, retinal detachment leads to afferent pupillary defect)
    - **Ultrasound**

- **When to treat**? If the pt can’t perform his/her normal life (depends on pt’s needs and occupation)

- **Surgical techniques**:
  1. Phacoemulsification (the best and most commonly used)
  2. Extracapsular cataract extraction

Normal IOP? **10-21 mmHg**
**ANTERIOR CHAMBER:** We evaluate 2 things:

1. **DEPTH:**
   - Dislocation of the lens → deep AC
   - Subluxation of the lens (trauma, Marfan, homocystinuria, Weill-Marchesani syndrome) → here, due to a break in some of the zonules causing some part of the lens to subluxate and irregular depth of the AC
   - A-phakia or pseudophakia → deep AC
   - Myopia → long axial length → deep AC
   - Hyperopia → short axial length → shallow AC (**high risk of AACG**)

2. **CONTENT:**
   - Normally → clear aqueous humor
   - Uveitis → cells and flares

**IRIS:**

- Normal pattern → crypts and farrows
- Neurofibromatosis → Lisch nodules
- Coloboma → part of the iris is missing (it can be in the iris, lens, choreo-retinal layer, or all 3 together)
- Diabetic neuropathy → Rubeosis iridis; new vessels on iris (due to ischemia → VEGF → new vessels)

**CORNEA:**

- Discontinuity of the corneal epithelium
- MCC: contact lenses, fingernail, paper
- Nerve supply of the corneal → CN V (ophthalmic division) → runs beneath the epithelial layer, so when there’s an erosion in the epithelium, it becomes exposed and causes:
  1) Severe pain
  2) Ciliary spasm (afferent CN5, efferent CN3)

- **Treatment:**
  - **Patch** (to relieve pain, allow healing by preventing lid movement, and prevent infection)
  - **Cyclopentolate:** to relax ciliary muscle (cycloplegic)
  - **Ointment:** to lubricate and prevent infection
  - **If you suspect infection:** don’t patch it and apply abx and lubricant frequently

**Corneal reflex:**

1. Afferent → **CN5**: touching the cornea
2. Efferent → **CN7**: causes blinking
**Corneal ulcer:**

- An infected corneal abrasion with inflammatory infiltrates in the corneal stroma

- **Organism:**

  1. **Viral:** *slight discomfort, no discharge, Hx of w\ URTI*
     - Adenovirus
     - Herpes zoster -> CNS ganglion, reactivates due to decreased immunity
     - Herpes simplex -> dendritic ulcers
     - **Treatment:** topical antiviral (acyclovir) + abx (to prevent 2ndry bacterial infection)

  2. **Microbial:** severe pain, decreased vision, edema and congestion, colored mucopurulent discharge, hazy cornea w\ infiltrates
     - **Bacterial:** *most common is S. epidermis, most aggressive is gram negative bacilli*
     - **Treatment:**
       1) Admit (esp if centrally involved, good-eye involvement)
       2) Corneal scraping -> decrease bacterial load and to send for gram stain, culture and sensitivity
       3) Abx: ceftazidime + vancomycin (to cover for gram positive and negative)
       4) Cyclopentolate
       5) Don’t patch the eye
       6) Daily F\U: pain, visual acuity, AC infiltrates -> if present; do US to make sure no vitreous involvement (endophthalmitis)
     - **Fungal:** mainly chronic, can result by an injury from a wooden piece, r\out systemic cause, never ever give steroids!
     - **Protozoal**

**FUNDUS EXAM:**

- Either direct or indirect
**DISC:**

- **Contour:** normally, it should be sharp and clear
- **Cup:** normal cup-to-disc ratio is 0.3
- **Filling of the cup:** one of the earliest signs of papilledema
- **Color:** normal is orange-pink
  - If grey or pale -> optic nerve atrophy
  - **Hyperemic (tortuous vessels)** -> optic disc swelling; either due to papilledema or optic neuritis
    - **How to differentiate?** *Optic neuritis: afferent pupillary defect and poor vision*

<table>
<thead>
<tr>
<th></th>
<th>Papilledema</th>
<th>Papillitis</th>
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<tr>
<td><strong>Definition</strong></td>
<td>Swelling of optic nerve head due to increased ICP</td>
<td>Inflammation or infarction of optic nerve head</td>
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<td><strong>Unilateral/bilateral</strong></td>
<td>Bilateral</td>
<td>Unilateral</td>
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<td><strong>Vision impairment</strong></td>
<td>Enlarged blind spot</td>
<td>Central/paracentral scotoma to complete blindness</td>
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<td><strong>Fundus appearance</strong></td>
<td>Hyperemic disk</td>
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<td><strong>Vessel appearance</strong></td>
<td>Engorged, tortuous veins</td>
<td>Engorged vessels</td>
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<td><strong>Hemorrhages?</strong></td>
<td>Around disk, not periphery</td>
<td>Hemorrhages near or on optic Head</td>
</tr>
<tr>
<td><strong>Pupillary light reflex</strong></td>
<td>Not affected</td>
<td>Depressed</td>
</tr>
<tr>
<td><strong>Treatment</strong></td>
<td>Normalize ICP</td>
<td>Corticosteroids if cause known</td>
</tr>
</tbody>
</table>

**VESSELS:**

- **Obliterated** -> branch vein/artery occlusion
- **Nicking/narrow** -> hypertensive retinopathy
- **Dilated and tortuous** -> papilledema, post uveitis, sarcoidosis, DM retinopathy
1. NON-PROLIFERATIVE:

- Ischemia -> micro-angiopathy (vessels are losing their layers) -> **first thing:** micro-aneurysm
- **Signs on fundoscopy:** 1. microaneurysm, 2. hemorrhages, 3. hard exudates (lipid deposits), 4. edema
  - Dot-blot hemorrhages: deep, impacted layers
  - Flame-shed hemorrhage *(elevated on the retina)*: superficial in nerve fiber layer *(more with HTN)*
- Classification:
  1. **Mild non-proliferative:** if 1 or all 4 signs are found in 1 quadrant
  2. **Moderate non-proliferative:** if 1 or all 4 signs are found in 2 quadrants
  3. **Severe non-proliferative:** if 1 or all 4 signs are found in 3 or all quadrants
- **Signs of ischemia:**
  - First thing: tortuous veins
  - IRMA: intra-retinal microvascular abnormality: collateral from non-ischemic areas to ischemic areas: normal walls and flat on the retina
  - Cotton wool spots due to edema causing micro-infarctions *(what differentiates mild from moderate non-proliferative)*

2. PROLIFERATIVE:

- Formation of new abnormal vessels with abnormal layers (very fragile, no normal branching) coming from the venous site -> random tufts of fibrovascular tissue -> can pull on the retina and cause retinal tears, vitreous hemorrhages, **Sub-hyaloid hemorrhage** *(between the vitreous and retina - “boat-shaped”)*
- **Location:**
  - On the optic disc itself -> new vessels on the disc *(NVD)*
  - Outside the disc -> new vessels elsewhere *(NVE)*
  - On the iris -> new vessels on the iris *(NVI)*

**Treatment:** *(the vision is intact, so it’s sometimes difficult to convince the pt they need treatment!)*

- **Non-proliferative:** control of DM, and other risk factors *(HTN, DLP)*, by medications and lifestyle *(diet and exercise)*:
  - Mild: f/u every 6 month
  - Moderate: f/u every 4 months
  - Severe: f/u every 2 months
  - **Primary treatment in DM retinopathy:** laser
  - **Primary treatment in DM maculopathy:** anti-VEGF
- **Proliferative:** Argon laser panretinal photocoagulation *(laser ablation)*; **destroys the normal peripheral retina (visual field and night vision) for the sake of the central retina (central vision, acuity, color).** How? less surface area -> less demands -> less ischemia
  - **Diabetic maculopathy:** *(edema of the macula)*

- Unlike diabetic retinopathy, it leads to poor visual acuity
- It has no relation of the severity of the diabetic retinopathy, can happen at any stage of the retinopathy *(mild, moderate, severe)*
- Treated by anti-VEGF *(sometimes we use laser, but risk of scarring of the macula and permanent loss of vision)*
**SQUINT (STRABISMUS):**

**Pseudo-strabismus:**
- When you look at both eyes straight, they appear as if the pt has squint, but when you do the cover/uncover test -> the eyes don’t move (eso, exo, hyper, hypo-tropia)
- Can be pseudo-esotropia -> due to the appearance of epicanthal folds
- Can be pseudo-exotropia -> due to diversion of the globe externally (extorsion)

**True strabismus:**

Latent: Heterophoria (eso-, exo-, hyper-, hypo-phoria)
- If you look at both eyes, they’re both straight, but when you interrupt binocular vision by covering one eye -> the heterophoria appears. And comes back when you uncover

Heterotropia (eso-, exo-, hyper-, hypo-tropia): unilateral vs alternating:
- If you look at both eyes straight, the left eye is straight, while the right is esotropia -> if cover the left, the right will fix and centralize
- If you uncover:
  - And the right comes back to esotropia; then the squint is unilateral (in the right eye only)
  - If it’s remains fixed; then the squint is bilateral (alternating)
- **Treatment:**
  - *Unilateral:* surgery to the affected eye only, **risk of amblyopia**
  - *Alternating (bilateral):* surgery to both eyes, no risk of amblyopia

**Random notes:**

- **Most common retinal tumors:**
  - In *pediatrics:* Retinoblastoma
  - In *adult:* choroidal melanoma

- **Retina -> 10 layers; their blood supply:**
  - *Inner layers:* retinal vessels
  - *Outer layers:* diffusion from choroid (highest vascularized organ in the body)

- **Bell’s phenomenon** is protective reflex in which the globe is turned upwards and slightly outwards during the eyelid closure to avoid corneal exposure (CN 3 and CN 7)

**References:**

- Dr Galmady’s CTR
- Dr Aly’s PDT
- Toronto notes