

Eye Trauma

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ORBITAL FRACTURES – see p. TrH27 >>	

Document legally (in any patient with upper facial trauma): vision, range of extraocular motion, location of lid and conjunctival lacerations and foreign bodies, depth of anterior chamber, anterior chamber / vitreous hemorrhage, cataract.
Ocular trauma accounts for 8-10% of all visual impairments!

Prehospital management – see p. TrH25 >>

HYPHEMA

- blood accumulation in anterior chamber.



CLASSIFICATION

Traumatic hypHEMA (even small hypHEMA can be sign of major intraocular trauma!)

Grade 1 - occupying < 1/3 of anterior chamber

Grade 2 - filling 1/3-1/2 of anterior chamber

Grade 3 - filling > 1/2 of anterior chamber

Grade 4 - total filling.

Spontaneous hypHEMA - secondary to neovascularization, ocular neoplasms, vascular anomalies.

CLINICAL FEATURES

- < 50% hypHEMAS settle inferiorly to form **level**; 40% form definite **clot adherent to iris stroma**; 10% have dark **clot in contact with endothelium** (poor outcome and corneal staining).
- tear at *anterior aspect of ciliary body* is most common site of bleeding (71%).
- usual duration of uncomplicated hypHEMA is 5-6 days; mean duration of elevated IOP is 6 days.

COMPLICATIONS

1. **Elevated IOP** - may accompany hypHEMAS of any size (esp. with near total or total hypHEMAS); periods:
 - 1) HYPERTONIA - during acute phase of hypHEMA (first 24 hours after injury) - **trabecular plugging by erythrocytes and fibrin**.
 - 2) HYPOTONIA (\leq normal IOP) from 2nd to 6th day - due to **reduced aqueous production and uveitis**.
 - 3) HYPERTONIA - recovery of ciliary body.
 - 4) NORMOTONIA - recovery of trabecular meshwork (disappearance of hypHEMA)

Glaucoma may result:

 - a) if large segments of anterior chamber angle are irreparably damaged and/or clot organization produces extensive peripheral anterior synechiae → **intractable GLAUCOMA**.
 - b) erythrocytes lose hemoglobin and become ghost cells in vitreous cavity → circulate forward into anterior chamber with resultant trabecular blockage → delayed **GHOST CELL GLAUCOMA**.
2. **Secondary hemorrhage** into anterior chamber (\approx 25%) usually in first 3 days.
 - due to clot lysis and retraction.
 - markedly worsens prognosis.
3. **Posterior synechiae**
 - secondary to iritis or iridocyclitis.
4. **Peripheral anterior synechiae**
 - occurs if hypHEMA has remained in anterior chamber for prolonged period (> 9 days).
5. **Corneal bloodstaining**
 - more likely in total hypHEMA that remains for at least 6 days with IOP > 25 mmHg.
 - clearing of corneal bloodstains may require many months.
6. **Optic atrophy**
 - due to \uparrow IOP.
 - for black patients (with sickle cell trait), prevention of secondary hemorrhage is critical factor!

TREATMENT

1. **PATCHING** (bilateral or injured eye only).
2. **BED REST**, elevating bed head 30-45° (→ hypHEMA settling in inferior anterior chamber).
3. **SEDATION** in extremely apprehensive individual.
4. If **analgesics** are required, avoid aspirin and other NSAIDs with antiplatelet effect.
5. **Topical medications:**

- 1) **AMINOCAPROIC ACID** (some administer orally) - prevention of recurrent hemorrhages; clot will persist in anterior chamber for increased period – so avoid in grade 4 hyphema.
 - 2) **antiglaucomatous** medications - initiate therapy incrementally with **BRIMONIDINE**, followed by **LATANOPROST** and **TIMOLOL**; if IOP is still elevated, add **CARBONIC ANHYDRASE INHIBITOR**.
 - 3) **steroids** (after 3-4th day of retained hyphema) - to decrease iridocyclitis and to prevent synechiae.
 - 4) **atropine** (indicated in grade 3-4 hyphemas) - to break pupillary block.
- Any other **topical medications** lack definite evidence of advantages!!!
6. **Surgical evacuation** – indicated in:
- 1) **grade 3-4 hyphemas** persisting for > 4 days.
 - 2) **microscopic corneal bloodstaining** (at any time); most typical early sign of corneal bloodstaining is tiny yellowish granules in posterior third of corneal stroma - surgical treatment in this early stage may prevent gross staining, and cornea may clear in 4-6 months.
 - 3) **IOP ≥ 50 mmHg** for 4 days (or ≥ 35 mmHg for more than 24 hours if sickle cell trait or disease is present!)
- preferred technique is **evacuation with closed vitrectomy instrumentation**.
 - other methodologies – paracentesis, irrigation & aspiration through small incision, clot irrigation with trabeculectomy.
 - extreme care is required to **avoid any contact with iris, lens, or corneal endothelium**.

FOREIGN BODIES

Typical patient - 20-40 yrs male who does not wear protective eye gear.

- most injuries occur at work using various tools with **metal striking metal** – patient feels something enter eye with no obvious external changes; hence, incident usually is dismissed quickly.

Avoid pressure on globe!

CONJUNCTIVAL, CORNEAL foreign bodies

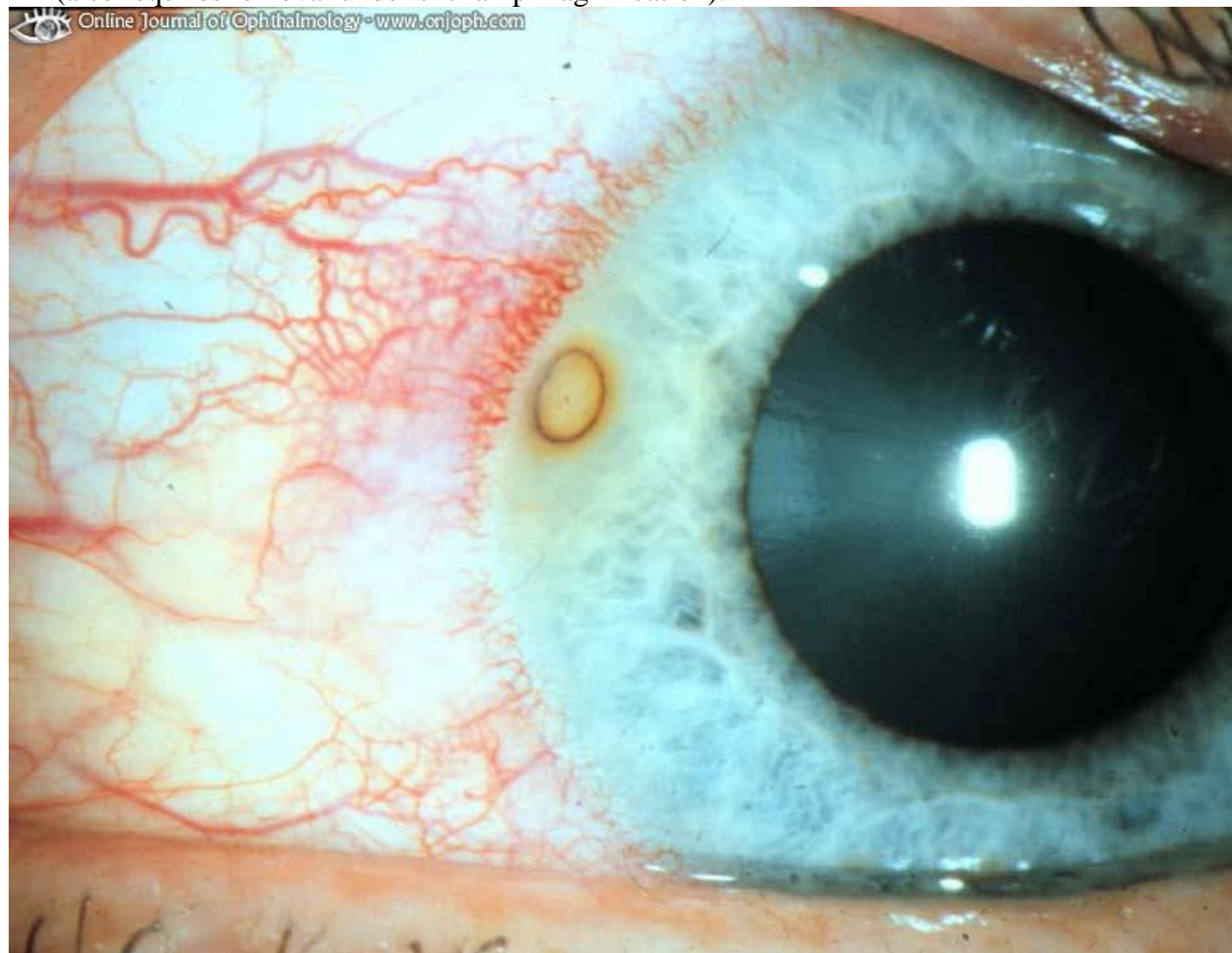
1. Apply **anesthetic** and **fluorescein staining**
2. Evert individually both lids.
3. Inspect with binocular lens (loupe) or slit lamp.
4. Remove foreign body:

Conjunctival → **moist sterile cotton applicator**.

Corneal → **irrigation**;

if cannot be dislodged → lift out on point of **sterile spud / hypodermic needle** under slit-lamp magnification.

N.B. unless **steel / iron foreign bodies** are removed immediately, they leave **rust ring on cornea** (also requires removal under slit-lamp magnification):



Source of picture: "Online Journal of Ophthalmology" >>

Burr removal of metallic rust ring:



5. **Antibiotic ointment** (**BACITRACIN/POLYMYXIN B** or **SULFACETAMIDE SODIUM 10%**).

- for larger foreign bodies, treatment is as for corneal abrasion (short-acting cycloplegic + antibiotic + firm patch to keep eye closed overnight).
- corneal epithelium regenerates within 1-3 days.

N.B. **corticosteroids are contraindicated** (promote growth of fungi and herpes simplex virus)!!!

INTRAOCULAR foreign bodies

DIAGNOSIS

Slit lamp examination:

- **entry sites**:
 - in cornea - disruption in smooth surface with corneal edema surrounding perforation site.
 - in sclera - area of conjunctival injection; darker pigmentation indicates choroidal exposure.

- examine **iris** before dilatation (disruption point?) and **lens** after dilatation (cataract?).

Dilated fundus examination reveals foreign bodies in **posterior segment**.

Fine CT with 2-mm sections can localize foreign bodies as small as 0.7 mm.

X-ray - beneficial for **metallic** foreign bodies.

MRI - more effective in localizing **nonmetallic** foreign bodies.

Do not use if cannot exclude metallic objects!!!

Ultrasound is useful adjunct tool to determine if object is metallic.

TREATMENT

Require **immediate surgical removal** (delay of 24 hours increases endophthalmitis risk to 13.4%):

Inert substances - glass, stone, plastic (may be removed at later time after initial wound is closed).

Metals – oxidize (*copper / iron should be removed urgently* – can cause **CHALCOSIS / SIDEROSIS** - toxic to retina!!!)

Organic material - ↑ risk of endophthalmitis.

- systemic and topical **antimicrobials** are indicated; TETANUS prophylaxis.
- **minimize pressure on globe** even in cases of self-sealing wounds.
- surgical approach varies with object location.
- removal **through original entry wound** is **not recommended**.

Object in anterior chamber

- lens is intact - constrict pupil with miotics to reduce risk of lenticular injury.
- 20-gauge rare earth **MAGNET** may retrieve small metallic objects; nonmagnetic objects or large magnetic objects are managed best with **INTRAOCULAR FORCEPS**.
- damaged lens should be removed (usually via phacoemulsification); concurrent IOL insertion is not performed (because calculation of intraocular lens power may not be exact).

Object in posterior chamber

- to reduce risk of intraocular content extrusion, anterior chamber paracentesis is performed to soften eye.
- a) **external approach** - via sclerotomy and electromagnet.
- b) **internal approach** – via vitrectomy; very large objects sometimes are managed best through limbal incision.

CONTUSIONS & LACERATIONS

Lid contusions (black eye)

ice packs to inhibit swelling - during first 24 h;

hot compresses to aid absorption - next day.

Lid lacerations → repair with fine sutures in at least three layers (to prevent notching as healing progresses):

6-0 absorbable suture for deep layer (conjunctiva and tarsus) - knots tied into wound;

5-0 chromic sutures for middle layer (orbicularis oculi muscle);

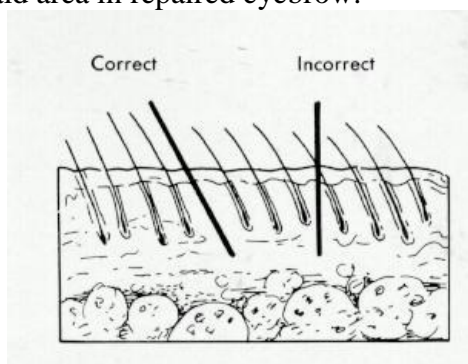
6-0 nonabsorbable suture (e.g. silk) for skin.

Traumatized lids should never be opened forcibly - injury could be aggravated!

- patch eye.
- lacerations **involving lid margin** or **loss of lid tissue** should be dealt by ophthalmologist (if injury prevents tears from keeping cornea moist → artificial tears).
- lacerations **near medial canthus** - danger of violating lacrimal apparatus. *see below*

Eyebrow lacerations

- carefully explore wound - fracture may be palpated (that does not visualize on X-ray).
- minimum debridement - eyebrow is very difficult to reconstruct.
 - debridement should be done **parallel to hair follicles** (not perpendicular to skin, as is general rule) – to minimize bald area in repaired eyebrow:



- any defect in muscle layers is approximated with deep sutures (to prevent functional defect or depressed scar).
- during wound closure, eyebrow **borders should be aligned first** to avoid visible step-off (for this reason eyebrow should not be shaved - would destroy landmarks for accurate closure).

Eyebrow avulsion

- can be replaced with hair-bearing tissue from postauricular area.

- keep graft < 1 cm in width to ensure its survival.
- graft pedicled on anterior branch of superficial temporal artery also may be used.

Lacrimal canaliculus laceration

- > 50% tear volume is normally evacuated through inferior canaliculus - when this pathway is interrupted it is important that it be repaired when possible.
 - any laceration in medial third of lower lid - suspect injury to inferior canaliculus.*
- diagnosis (after hemostasis):
 - a) place probe (e.g. small nylon or polypropylene suture) through punctum into wound.
 - b) insufflate canaliculus with air and instill sterile saline into laceration → air will bubble through saline.
 - c) instill fluorescein in conjunctival sac - observe dye in wound.
- treatment: **Vier stainless steel rod** (with swaged-on black silk) is passed through punctum into laceration site and then into medial portion of canaliculus, to align cut ends; laceration is stabilized with small chromic sutures; free end of suture of rod is tied in place to help stabilize rod and is used to retrieve it for removal; rod is left in place for 4-6 weeks.

Trauma to globe

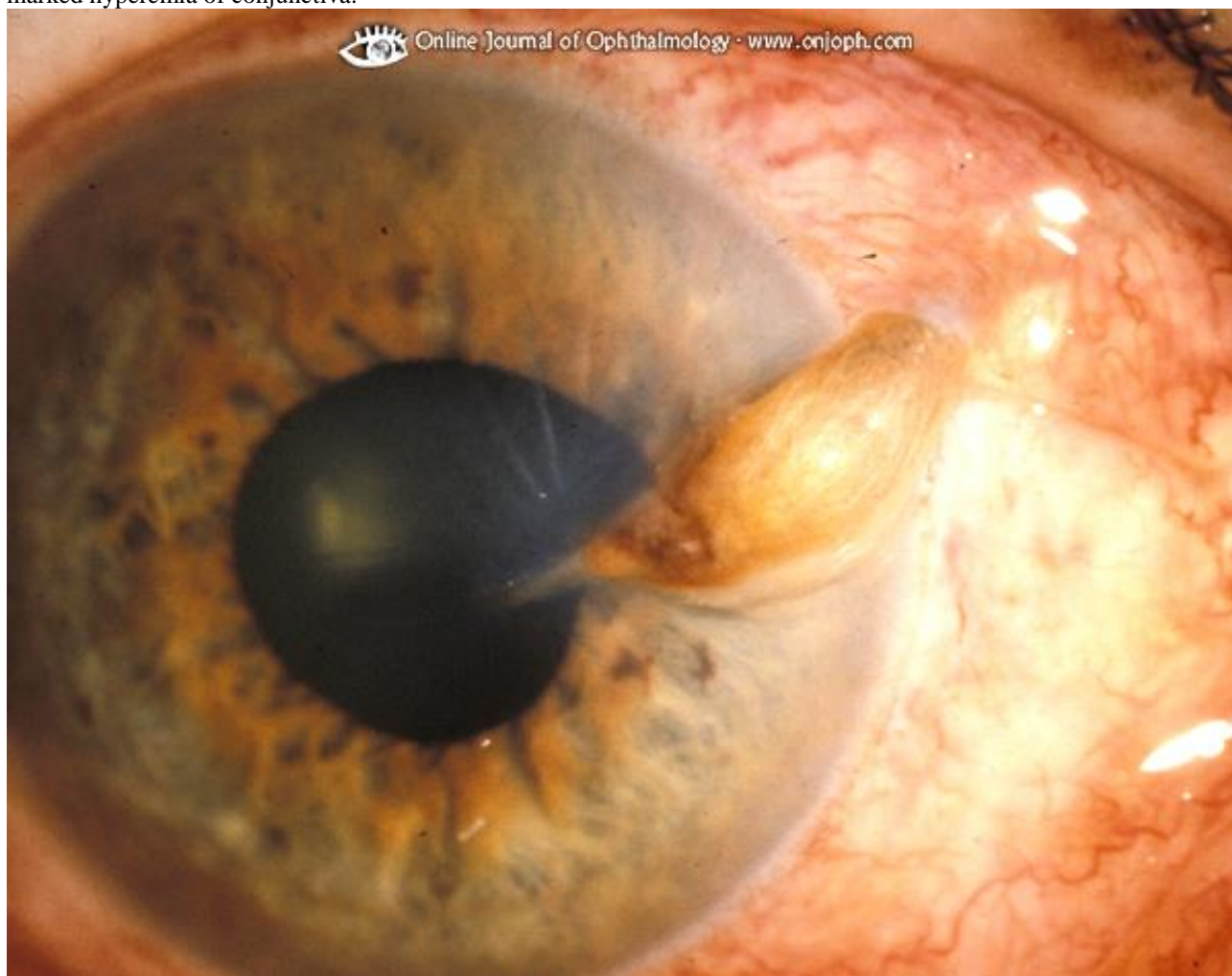
PERFORATING INJURY – **sclera partially torn**.

PENETRATING INJURY – **sclera complete rupture**.

- corneal laceration - **irregular (“teardrop”) pupil** due to iris prolapse through cornea.
- globe laceration risks **sympathetic ophthalmia**.
- emergency treatment:
 - 1) protective rigid shield

- 2) analgetics
 - 3) cyclopentolate 1% + phenylephrine 2.5%
 - 4) antimicrobials (systemic / local - drops only, since ointment could penetrate lacerated globe!)
- corticosteroids are *contraindicated* until wounds are closed surgically.

Severe windshield injury after 7 days - iris tissue has prolapsed through corneal wound, pupil is peaked toward prolapse, marked hyperemia of conjunctiva:



Source of picture: "Online Journal of Ophthalmology" >>

Traumatic optic neuropathy - impact injury to optic nerve (without concomitant facial fracture or penetrating wound) → instantaneous (rarely delayed) *permanent visual loss*

- occurs in 0.5-5% closed head injuries.
- treatment - **high-dose steroids** (≈ acute spinal cord injury).

BURNS

Lid burns - cleanse thoroughly with **sterile saline** → apply petrolatum gauze or **antimicrobial ointment** → **sterile pressure dressing** held by elastic bandage around head until surface has healed.

Chemical burns of cornea / conjunctiva

Symptoms & signs – pain, hyperemic edema, eyelid burns, corneal opacification & epithelial defects, anterior chamber reaction (hazy fluid), possibly ↑ IOP.

Treatment:

- 1) **immediate copious irrigation** with water, saline, or other bland fluid; for at least 30 min; holding eyelids open [e.g. Morgan lens]; repeatedly assess pH of inferior fornix (with *litmus paper*) until it becomes neutral (recheck after 5-10 min).
 - 2) **anesthetize** eye with 1 drop of **PROPARACAINE** 0.5% (→ oral analgetics)
 - 3) assess extent of injury (incl. visual acuity, slit lamp)
 - 4) **antibiotic ointment**
 - 5) pressure **patching**, artificial tears.
 - 6) **steroids** are helpful.
- *chemical iritis* → long-acting cycloplegic (e.g. **ATROPINE** 1%).
 - corneal scarring, opacification is risk.

IRIDODIALYSIS, CYCLODIALYSIS

IRIDODIALYSIS - disinsertion of iris from scleral spur; **elevated IOP** can result from damage to trabecular meshwork or from formation of peripheral anterior synechiae (PAS).



CYCLODIALYSIS - disinsertion of ciliary body from scleral spur; increased uveoscleral outflow occurs initially resulting in hypotony (later, IOP elevation can result from closure of cyclodialysis cleft).

CLINICALLY

- asymptomatic unless glaucoma develops.

TREATMENT

- **sunglasses, contact lenses** with artificial pupil.
- **surgical correction** if large iridodialysis and patient symptomatic.
- if **glaucoma** develops → treatment similar to primary open-angle glaucoma.
N.B. avoid **miotics** - may reopen cyclodialysis clefts, causing hypotony; strong **mydriatics** may close clefts, resulting in pressure spikes.

COMMOTIO RETINAE

ETIOLOGY

- **contrecoup injury** (blunt trauma to globe causes shock waves which travel posteriorly and lead to disruption of photoreceptors).

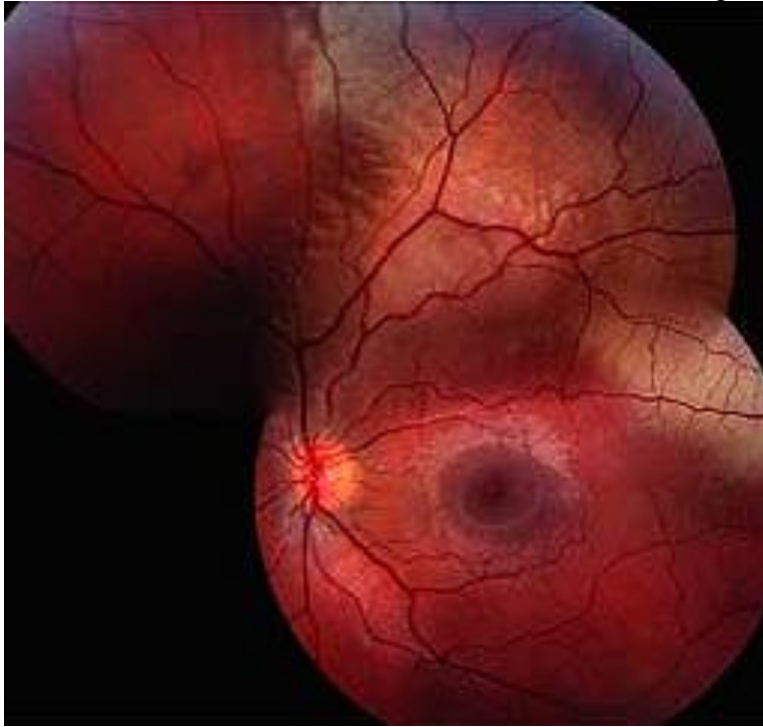
CLINICALLY

- decreased vision or asymptomatic; history of recent ocular trauma.

FUNDUSCOPY

- confluent **area of retinal whitening** (visual acuity does not always correlate with degree of retinal whitening).

- whitening is intracellular edema and fragmentation of photoreceptor outer segments and intracellular edema of retinal pigment epithelium; no intercellular edema.
- when occurs in *macula* is called **Berlin edema**.
- retinal blood vessels are undisturbed in area of retinal whitening!

**TREATMENT**

No treatment is required - [clears without therapy!](#)

BIBLIOGRAPHY for ch. "Ophthalmology" → follow this [LINK >>](#)