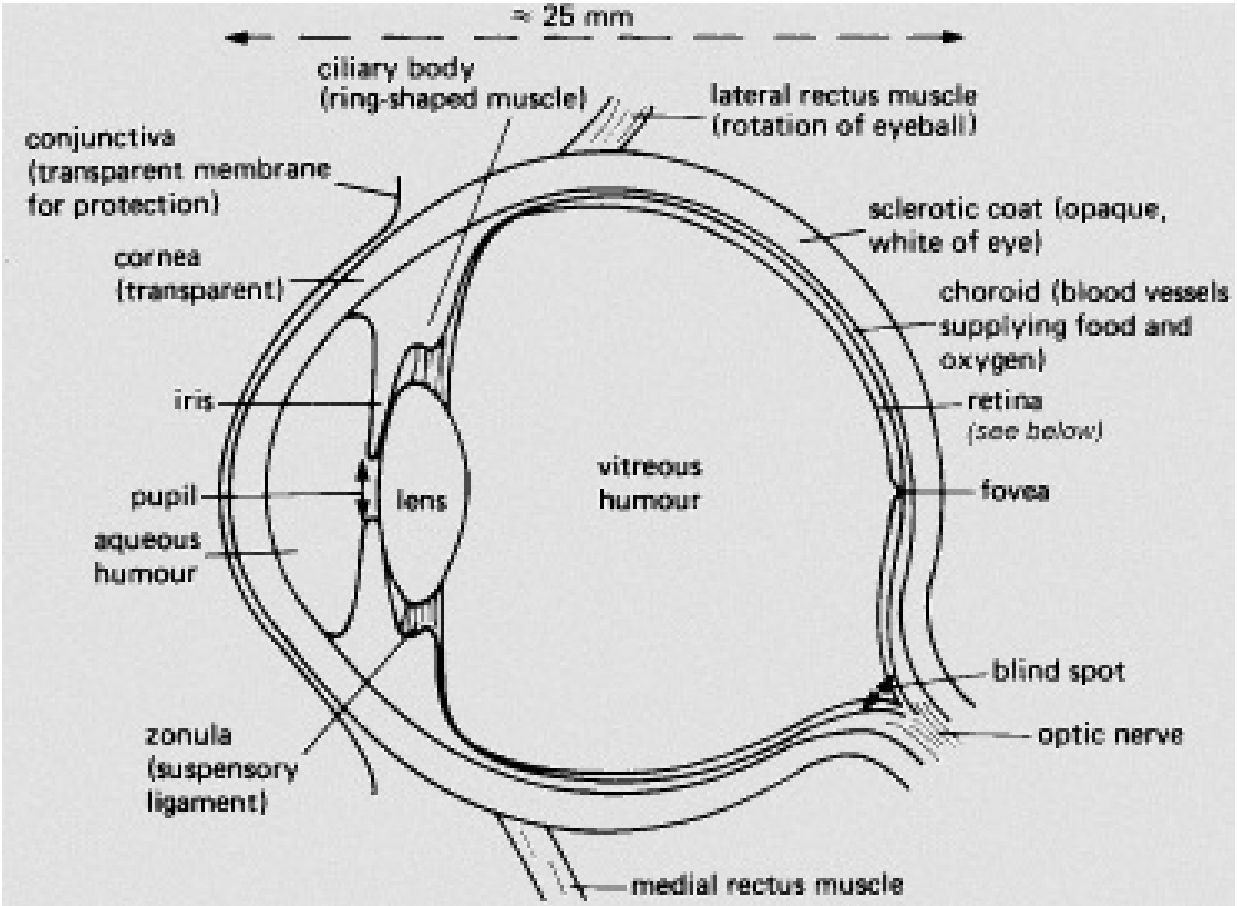
title

Eye description

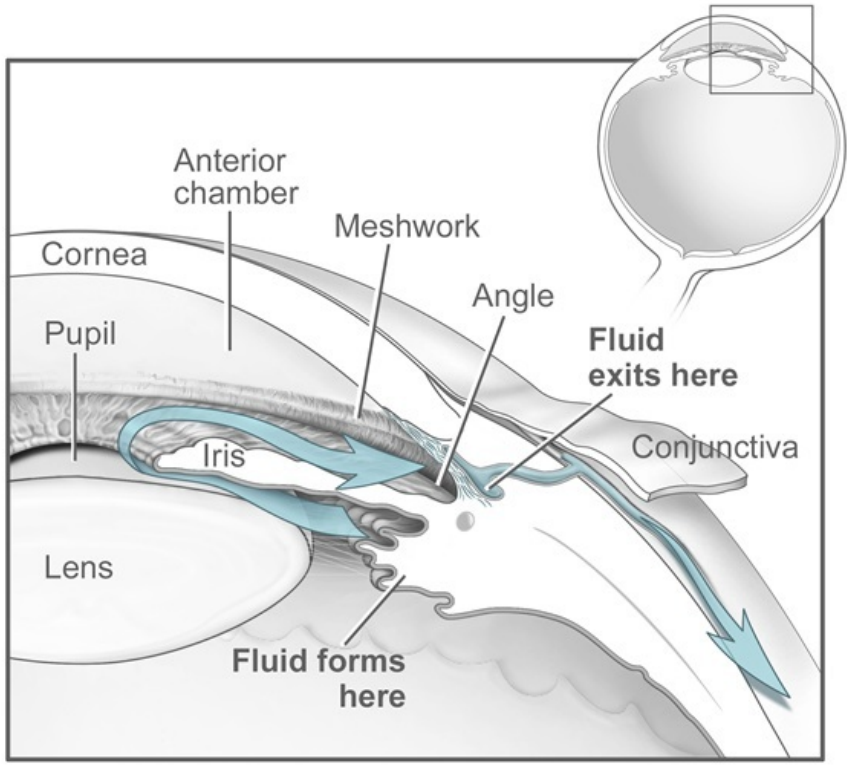
Eye is the organs of vision ; it allows the conversion of light into impulses in neurons



source : `http://academia.hixie.ch/bath/eye/home.html`

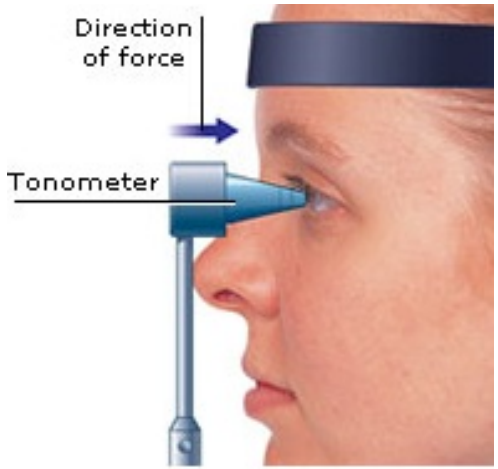
Eye description

Aqueous humor : produced by the ciliary epithelium. $\rightarrow$ drains into the Schlemm's canal.
Pressure produced : the intra-ocular pression (IOP).



IOP : 10 – 22 mmHg for human (average : 16 mmHg)

- inflates the globe of the eye
- measure (tonometry) takes into account the thickness

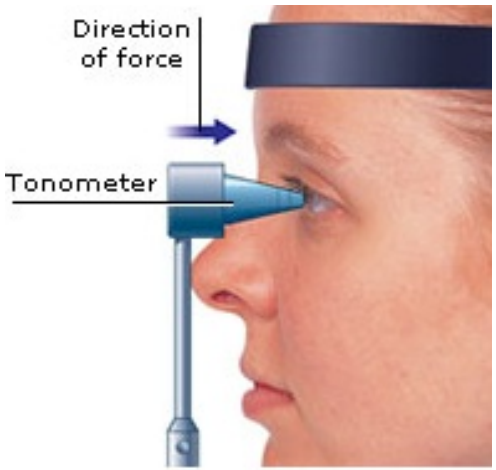


source : http://www.aviva.co.uk/health-insurance/home-of-health/medical-centre/medical-encyclopedia/entry/test-tonometry/

IOP

IOP : 10 – 22 mmHg for human (average : 16 mmHg)

- inflates the globe of the eye
- measure (tonometry) takes into account the thickness



source : http://www.aviva.co.uk/health-insurance/home-of-health/medical-centre/medical-encyclopedia/entry/test-tonometry/

High IOP $\Rightarrow$ major risk for *glaucoma*.

Glaucoma

- Second leading cause of blindness worldwide (1 in 40 adults over 40 years old) [1]

Elevated IOP : major risk for glaucoma, but :

- a patient with an elevated IOP may never contract glaucoma.
- a patient could have a glaucoma even though his IOP is low

25 % of IOP-treated patient progress to blindness

1. *Relative roles of risk factors in the evaluation of a glaucoma suspect : clinical perspective and mthematical modelling*,Geffen, Guidoboni, Harris *et al*

Glaucoma

Group of ocular disorders with multi-factorial etiology united by a clinically characteristic optic neuropathy accompanied by a vision loss. There are two kinds of diagnostics :

Glaucoma

Group of ocular disorders with multi-factorial etiology united by a clinically characteristic optic neuropathy accompanied by a vision loss. There are two kinds of diagnostics :

- a morphological damage

Glaucomateous optic nervehead demonstrating increased cup to disc ratio

The glaucoma damage the optical nerve head, where the optical nerve and blood vessels enter the retina.

Glaucoma

Group of ocular disorders with multi-factorial etiology united by a clinically characteristic optic neuropathy accompanied by a vision loss. There are two kinds of diagnostics :

- a morphological damage
- a physiological damage (decrease of the visual field)

source : http://www.swisscompleteeyecare.com/uploads/3/6/3/8/3638142/8901258.jpg?520

Glaucoma

Group of ocular disorders with multi-factorial etiology united by a clinically characteristic optic neuropathy accompanied by a vision loss. There are two kinds of diagnostics :

- a morphological damage
- a physiological damage (decrease of the visual field)

However, the IOP remains the only parameter we can act on, either by surgery or with medications.

Treatment

The medications have two effects :

Decrease the secretion of aqueous humor	Increase the elimination of aq
beta-adrenergic receptor antagonists Alpha2-adrenergic agonists alpha agonists Carbonic anhydrase inhibitors	Prostaglandin analo Miotic agents

It is also possible to combine several treatments in order to decrease even more the IOP. Besides, drugs could work better on patients depending on their age, gender, ethnic group or other diseases like diabetes, hypertension...

Model of intraocular fluids dynamics

$$\frac{\mathrm{d}U}{\mathrm{d}t} = F_h - F_e$$

U : Total aqueous humor
F_h : Fluid inflow in posterior chamber
F_e : net inflow via trabecular path

$$F_h = L_p\left[(p_a - p) - \sigma_p \Delta\pi_p - \sigma_s \Delta\pi_s\right]$$

L_p : permeability of the equivalent membrane
p_a : pressure in the ciliary body capillaries
p : IOP
σ_p : reflection coefficient (proteins)
σ_s : reflection coefficient (low molecular components)
$\Delta\pi_p$: osmotic pressure diff. accross membrane (proteins)
$\Delta\pi_s$: osmotic pressure diff. across membrane (low molecular component)

$$\Delta\pi_s = \rho(C_1 - C_2)$$

ρ : universal gas constant $\times$ absolute temperature
C_1 : total molar concentration of low-molecular components (blood)
C_2 : total molar concentration of low-molecular components (intra-ocular fluid near ciliary body surface)

$$\alpha\frac{dp}{dt} = F_h - \frac{p - p_e}{R}$$

$$V^*\frac{dC_2}{dt} = Q_s - Q_e = \xi_s(C_1 - C_2) + F_h(1 - \sigma_s)\bar{C} + J - F_h C_2$$

$V^\star$: volume of intraocular fluid between the folds of the ciliary body
ξ_s : average permeability of membrane for low-molecular species
$\overline{C}=\frac{C_1 + C_2}{2}$
J : Influx due to active transport p_e : pressure in the episcleral veins
R : output hydraulic resistance
α : volume compliance of the eye shell (varies significantly)

Assumptions

Data

Recovering some values

Summary

-3 equations