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KO'ZNING OPTIK XUSUSIYATLARI

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Anotatsiya: *Ushbu maqolada ko'zning optik xususiyatlari, sistemasi va ba'zi tuzilishi, ko'zning to'r pardasida tasvirni xosil bo'lishi, ko'zning optik sistemasidagi kamchiliklari va ularni bartaraf qilish yo'llari to'g'risidagi materiallar keltirilgan.*

Kalit so'zlar: *Ko'zning optik sistemasi, ko'zning to'r pardasi , ko'zda buyum tasviri, miopiya, gipermitropiya, astigmatism, ko'rish o'tkirligi, katarakta.*

Odam ko'zi o'ziga xos optik asbob bolib, u optikada alohida o'rin tutadi. Bu, birinchidan, ko'p optik asboblarning ko'z sezishiga mo ljallangani, ikkinchidan odamning (va hayvonning) ko'zi evolyutsiya jarayonida taqsimlashgan biologik sistema sifatida, bionika doirasida optik sistemalarni loyihalash va yaxshilashga doir ba'zi g'oyalarni vujudga keltirishi bilan tushuntiriladi.

Ko'z tibbiyotchilar uchun faqat funksional buzilish va kasallanish qobiliyatiga ega bo'lgan a'zo hisoblanmay, balki ba'zi ko'zga taalluqli bo'lmagan boshqa kasalliklar to'g' risidagi axborot manbai hamdir.

Ko'rish tizimiga tushgan yorug lik elektr impulsiga aylanadi va u ko'rish nervlari orqali miyadagi markaziy nerv tizimiga beriladi.

Fotoretseptorlar segirligi juda yuqori bo'lib, unga tushgan kuchsiz. yorug'likni ham elektr impulsiga aylantirib beradi. Yorug'lik ta'sirida retseptor hujayralarida ma'lum biokimyoviy reaksiyalarni hosil qildiradi va harakat potensiali yuzaga keladi.

Ko'z nafaqat elektromagnit to'lqinni abul qiladi, balki ularni farqlay oladi ham. Buyum tasvirini va rangini, anday masofada joylashganini ham aniqlaydi. Tabiat bunga uzoq evolyutsiya tufayli erishdi.

Ba'zi umurtqali hayvonlar ham odam kabi ranglarni ajratadi.

Masalan, otlar, o'ylar va cho'chqalar faqat qizil va zangori ranglarni farqlaydi. Tunda ov qiluvchi hayvonlar, masalan, mushuklar, bo'rilar rangni farqlamaydi. Hayvonlar ultrabinafsha va infraqizil nurlarni farqlay olmaydi. Bunga sabab quyoshdan yerga amalda 290 nm dan kichik to'lqinlar yetib kelmaydi. Shu sababli hayvon va odamlarda bu to'lqin uzunligini sezuvchi organlar rivojlanmagan. Lekin, bundan ancha katta to'lqin uzunlikli

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ultrabinafsha nurlarni ham ko'z sezmaydi. Bunga sabab yugori energiyali ultrabinafsha nurlar ko'zdagi yoruglikka sezgir pigmentlarni buzishidadir.

Shu sababli gavhar va shishasimon suyuqlik nafaqat ultrabinafsha nurlarni, balki to'lqin uzunligi 400 nm ga yagin ba'zi ,to'r pardani kuydiradi. nurlarni ham kuchli yutadi. Agar bu nurlar energiyasi katta bo'lsa Infraqizil nurlarni oladigan bo'lsak, uni hayvonlar tanasining o'zi ham chiqaradi. 37°C da maksimal nurlanish 9-10 mkm to'lqin uzunlikka mos keladi. 1sm2 hayvon tanasi 50 mW quvvatli energiyani nurlaydi. Bu esa ko'zga quyoshdan tushadigan energiyadan ancha kattadir.

Odam ko'zining tuzilishi haqida qisqacha to'xtab olamiz. Ko'z kosasi asli ko'zning o'zi bo'lib 1-(Rasm), u uncha togri bo'lmagan shar shaklidadir; katta odamlarda uning old-orqa o'lchovi o'rtacha 24,3 mm, vertikal o'lchovi - 23,4 mm va gorizontal o'lchovi - 23,6 mm. Ko'zning devorlari konsentrik joylashgan uchta— tashqi, o'rta va ichki qobiqlardan iborat. Tashqi oqsil qobiq — sklera 1 ko'zning oldingi qismida shaffof qavariq muguz qobiq 2-muguz pardaga aylanadi.

Muguz pardaning qalinligi o'rtasida 0,6 mm ga yaqin, atrofida to 1 mm gacha bo'ladi. Optik xossalari bo'yicha muguz parda - ko'zning eng kuchli sindiruvchi qismidir. U go'yo ko'zga yorug'lik nurlari kiradigan derazadir. Muguz pardaning egrilik radiusi 7-8 mm, moddasinnig sindirish ko'rsatkichi 1,38 ga teng. Muguz pardaning tashqi qoplami ko'z qovoqlariga berkitilgan konyunktiv 3 ga o'tadi.

Skleraga qon tomirli qobiq 4 tutashgan bo'lib, uning ichki sirti ko'z ichida yoruglikning diffuzli sochilishiga to'sqinlik qiladigan xira-qora pigmentli hujayralar bilan qoplangan. Ko'zning oldingi qismida tomirli qobiq 5-rangdor pardaga aylanadi. Bu pardada doiraviy teshik-qorachiq 6 mavjud. Ko'z qorachig'iga ko'zning ichki tomonidan, bevosita ko'z gavhari 7-ikki tomonlama qavariq linzaga o'xshash shaffof va elastik jism yondashadi. Ko'z gavharining diametri 8-10 mm, oldingi sirti egriligining radiusi o'rtacha 10 mm, orqa egriligining radiusi - 6 mm. Gavhar moddasining sindirish ko'rsatkichi 1,4 dan biroz kattaroq.

Muguz parda va gavhar orasida ko'zning oldingi kamerasi 8 joylashgan bo'lib, u suvsimon namlik bilan, ya'ni optik xossalari bo'yicha suvga yaqin bo'lgan suyuqlik bilan to'lgan. Ko'zning gavharidan tortib, to orga devorigacha bo'lgan butun ichki qismi shaffof, shishasimon jism (9) deb ataluvchi dirildoq massaga to'la bo'ladi. Shishasimon jismning sindirish ko'rsatkichi suvniki kabidir.

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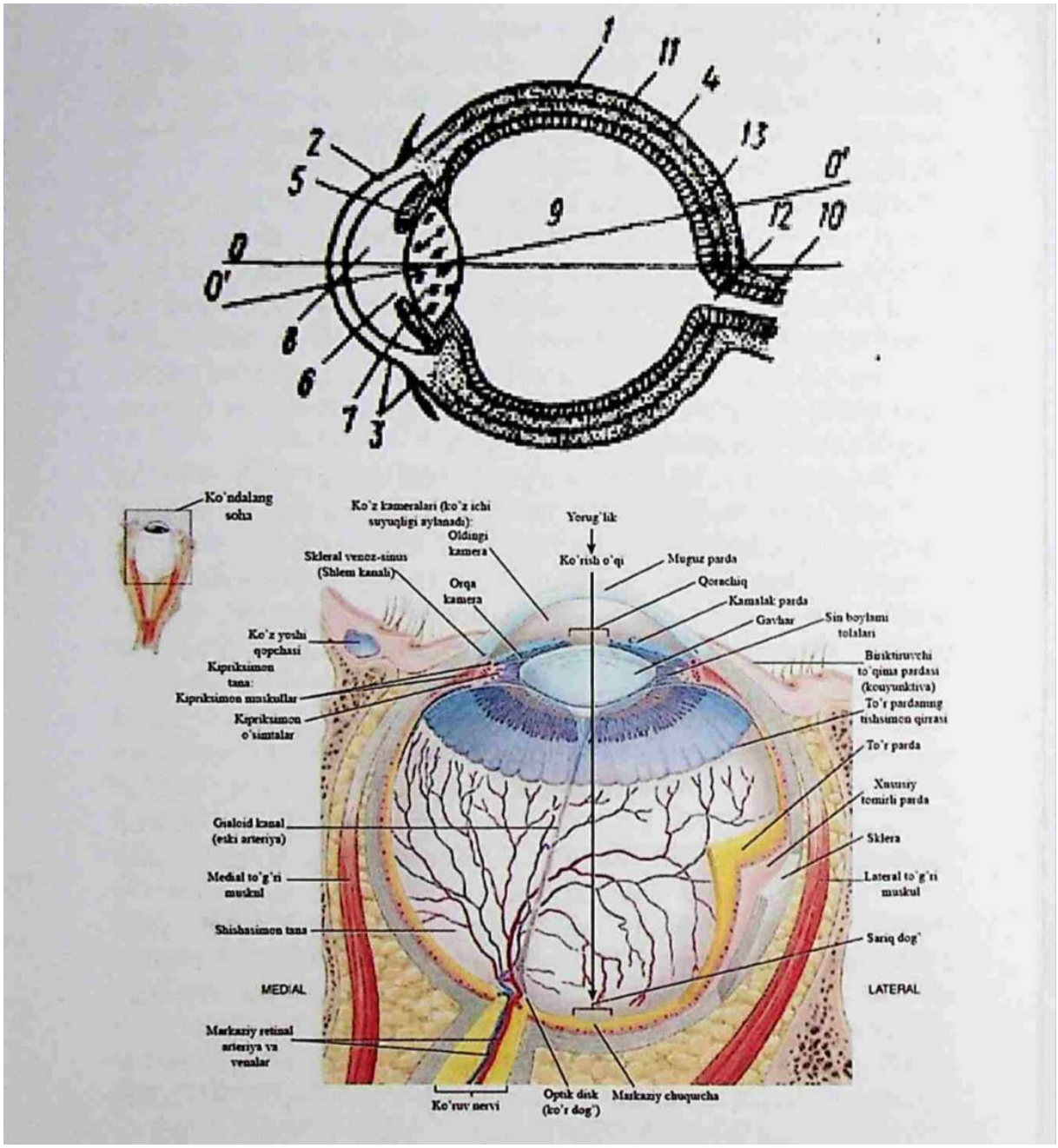

1-(Rasm)

Ko'zning yuqorida ko'rib chiqilgan elementlari asosan uning yorug'lik o'tkazuvchi apparatiga tegishlidir. Ko'ruv nervi 10 ko'z kosasiga orqa devordan kirib tarmoqlangach, u ko'zning eng ichki to'r qatlamiga yoki ko'zning yorug'likni qabul qiluvchi aparati (retseptori) bo'lgan to'r pardaga yoki retina 11 ga o'tadi. To'r parda bir necha atlamdan iborat bo'lib, qatlamlarning qalinligi va yorug'likka sezgirligi bir xil emas, unda periferik uchlari turli shakllarga ega bo'lgan yoruglik sezgir ko'ruv hujayralari joylashgan. Ularning cho'zinchoq uchlariga tayoqchalar, konussimon uchlariga kolbachalar deyiladi. Tayoqchalarning uzunligi 63-81 mkm, diametri 1,8 mkm ga yaqin, kolbachalar

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esa mos holda 35 mkm va 5-6 mkm bo'ladi. Kishi ko'zining to'r atlamida 130 millionga yaqin tayoqcha va 7 million kolbacha joylashgan.

Ko'ruv nervi kirgan joyda yorug'likni sezmaydigan ko'zning ko'r dog'i mavjud.

To'r pardaning o'rtasida, chekkaga yaqin yerda, yorug'ikka eng sezgir bo'lgan sariq dog' yotadi, uning markaziy qismi taminan 0,4 mm diametrga ega.

Kolbachalar va tayoqchalar to'r parda ustida bir tekisda tasimlangan. Kolbachalar to'r pardaning asosan o'rta qismida, sariq dog'da joylashgan, sarig dog'ning markazida faqat kolbachalar turadi, to'r pardaning chetlarida esa faqat tayoqchalar joylashgan.

Dastlab ko'zning yorug'lik o'tkazish apparatining xususiyatlarini ko'rib chiqamiz.

Ko'zni muguz parda, oldingi kamera suyuqligi va gavhar (to'rt sindiruvchi sirt) dan iborat va oldidan havo, orasidan esa shishasimon jism bilan chegaralanuvchi, markazlashgan optik sistema kabi tasavvur etish mumkin.

Bosh optik o'q 00 (1-rasm)muguz pardaning, qorachiqning va gavharning geometrik markalaridan o'tadi. Bundan tashqari yana ko'zning 00' ko'ruv o'qini ham mavjud ko'ruv o'qi eng yaxshi yorug'lik sezilishi yo'nalishini belgilaydi va gavhar bilan sariq dog' markazlaridan o'tadi, bosh optik va ko'ruv o'qlari orasidagi burchak taxminan 5° ni tashkil etadi. 2-rasmda biror o'rtacha normal ko'z uchun fokuslar, bosh nuqtalar, tekisliklar va tugun nuqtalar ko'rsatilgan (masofalar millimetrlarda berilgan).

Soddalashtirish maqsadida ko'pincha bu sistemani keltirilgan reduksiyalangan ko'z bilan, ya'ni buyumlar fazasi tomonidan sindirish ko'rsatkichi h = 1,336 ga teng suyuqlik bilan o'ralgan linza bilan almashtiriladi.

Keltirilgan ko'z modalarining birida yagona bosh tekislik muguz pardaning oldinig sirtidan 1,6 mm masofada turadi, tugun nuqtalar mos kelgan bo'lib, muguz parda sirtidan 7,2 mm masofada joylashgandir.

Yorug'likning asosiy sinishi muguz pardaning tashqi chegarasida yuz beradi, butun muguz pardaning optik kuchi taminan 40 dioptriyaga, gavharniki taminan 20 dioptriyaga, butun ko'zniki esa 60 dioptriyaga yaqin. 2-rasm

Turli uzoqlikdagi jismlar to'r pardada bir xil ravshanlikdagi tasvir berishi kerak. Buni amalga oshirish uchun (26.5) formuladan ma'lum bo'lishicha yo bosh tekislik bilan to'r parda orasidagi masofa a2 ni fotoapparatlarda gilinadiganga o'xshash o'zgartirish kerak, yoki gavhar egriligini, demak, F1 va F2 fokus masofalarini o'zgartirish kerak. Odam ko'zida ikkinchi hol amalga oshiriladi

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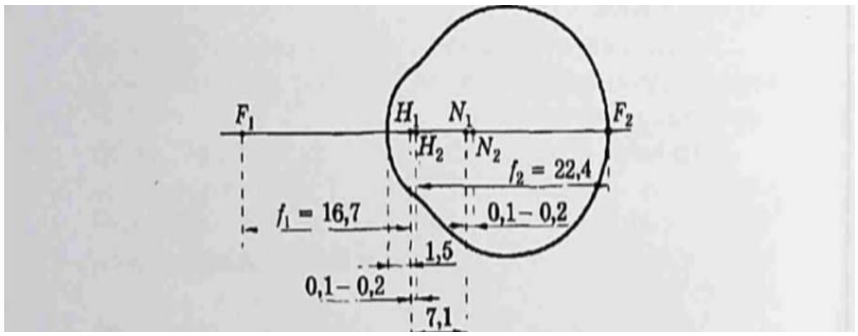
masofa



Ko'zning bunday har xil uzoqlikda joylashgan jismlarni ravshan ko'rishga moslasha olishiga - "keskinlikka to'g'rilanishiga" - akkomodatsiya deyiladi. jism cheksizlikda joylashgan bo'lsa, uning normal ko'zdagi tasviri to'r pardada bo'ladi. Bu vaqtda gavhar cheksizlikka akkomodatsiyalanadi va uning optik kuchi minimal bo'ladi. Jism ko'zga yaqinlashadigan bo'lsa, u holda gavharning egriligi kattallashadi, jism qancha yaqin bo'lsa, ko'zning optik kuchi shuncha katta bo'ladi, uning o'zgarishlari taxminan 60—0 dptr chegarasida bo'ladi.

Sog'lom katta odamda jism ko'zga 25 sm masofagacha yaqinlashgan vaqtda akkomodatsiya kuchlanishsiz ro'y beradi va qo'ldagi buyumlarni ko'rishga o'rganilib qolganligi sababli ko'z hammadan ko'p, ayniqsa shu masofaga akkomodatsiyalanadi, shuning uchun bu masofaga eng yaxshi ko'rish masofasi deyiladi.

Undan ham yaqin turgan buyumlarni ko'rish uchun akkomodatsion apparatni zo'riqtirishga to'g'ri keladi. To'r pardada tasvirning ravshan ko'rinishini hali ta'minlay oladigan ko'z bilan buyum ko'zning yaqin nuqtasi (aniq ko'rishning yaqin nuqtasi) deyiladi. Yosh ulg'aygan sari ko'zning yaqin nuqtasigacha bo'lgan kattalashadi, demak, akkomodatsiya kamayadi.

To'r pardadagi tasvirning kattaligi faqat buyum kattaligiga bog'liq bo'lmay, uning ko'zdan uzoqligiga ham, ya'ni jismning ko'rinishi burchagiga ham bogliq bo'ladi. Shunga ko'ra ko'rish burchagi tushunchasi kiritiladi. Bu buyumning chetki nuqtalaridan chiqib mos tugun nuqtalaridan o'tuvchi nurlar orasidagi burchakdir (3-rasm). Rasmdan ko'rinishicha, birinchidan har xil KM va QP buyumlar bir xil ko'rish burchagi ß ga ega bo'lishi mumkin, ikkinchidan, ko'rish burchagi to'r pardadagi tasvir kattaligini to'la ravishda aniqlay oladi.

Ko'zning ajrata olish qobiliyatini tasvirlash uchun eng kichik ko'rish burchagidan foydalaniladi, bu burchakda odam ko'zi buyumning ikki nuqtasini hali ajrata olish qobiliyatiga ega bo'ladi.

Bu burchak taxminan 1' ga teng, bu eng yaxshi ko'rish masofasida turgan nuqtalarning orasi 70 mkm ga teng bo'lishiga mos keladi. Bu holda to'r pardadagi tasvirning kattaligi 5 mkm ga teng, bu esa to'r pardadagi kolbachalardan ikkitasining orasida bo'lgan o'rtacha masofaga teng. Shuning uchun, agar ikki nuqtaning tasviri to'r pardada 5 mkm dan qisqaroq chiziqni egallaydigan bo'lsa, u

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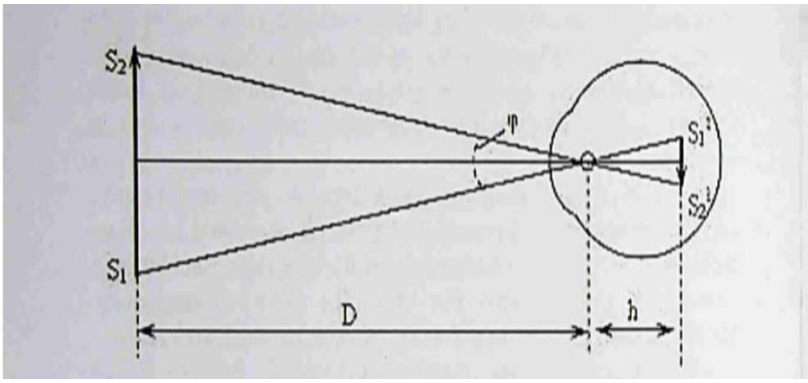
holda bunday nuqtalar ajralib ko'rinmaydi, ya'ni ko'z ularni
ajrata olmaydi.



3-rasm. Ko'zning to'r pardasida tasvirning hosil bo lishi

Yorug'lik difraksiyasi tufayli hosil bo'luvchi chegaralanishlar hisobga olinganda ham eng kichik ko'rish burchagining xuddi shunday qiymati olingan bo'ladi. Tabiatdagi maqsadga muvofiqlik "hech narsa ortiqcha emasligi" kishini hayron goldiradi, to'r pardaning yuza birligiga to'g' ri keluchi kolbachalar soni geometrik optikaning chegaraviy imkoniyatlariga javob beradi.

Ko'zning ajrata olish qobiliyatini tibbiyotda ko'rish o'tkirligi bilan baholaydilar. Ko'rish o'tkirligining normasi deb "bir" qabul qilinadi, bu holda eng kichik ko'rish burchagi 1' ga teng bo'ladi.

Agar bemorning eng kichik ko'rish burchagi 4' ga teng bo'lsa, uning ko'zi 1:4 = 0,25 o'tkirlikka ega bo'ladi.

Ayrim hollarda odam ko'zi 1' burchakka mos kelgandan ham maydaroq kattaliklarni ajrata oladi. Masalan, harakatlanuvchi jismlarning siljishi yoy bo'yicha 20" ga yetganda seziladi, ikki ingichka chiziqdan birining ikkinchisi ustiga tushmaganligini ular orasidagi burchak 12" bo'lganidayoq bilinadi va hokazo.

Fizik o'lchashlarda ko'pincha strelkasi shkalaning nolinchi darajasidan (shtrixidan) siljimasligi kerak bo'lgan asboblar (potensiometrlar, ko'priklar) ko'p ishlatilmoqda. Ko'zning kichik chiziqlarning siljishini seza olish gobiliyati tufayli bunday asboblar strelkasi bilan shtrixi orasidagi masofasi anilanadigan asboblarga ko'ra ancha anigroq ko'rsatishlar bera oladi.

KO'Z OPTIK SISTEMASIDAGI KAMCHILIKLAR VAULARNI BARTARAF QILISH

Ko'zning optik sistemasiga ba'zi kamchiliklar xosdir.

Akkomodatsiya yo'qligida normal ko'zning orqa fokusi to'r pardaga to' g'ri keladi, bunday ko'zga emmetropik ko'z deyiladi va bu shart bajarilmaydigan hollarda ametropik ko'z deyiladi.

Ametropiyaning eng ko'p tarqalgan ko'rinishlari yaqindan ko'rish (miopiya) va uzoqdan ko'rish (gipermetropiya) hisoblanadi. Bunga ko'z soqqasining shakli, ko'zning shoh pardasi yoki ko'z

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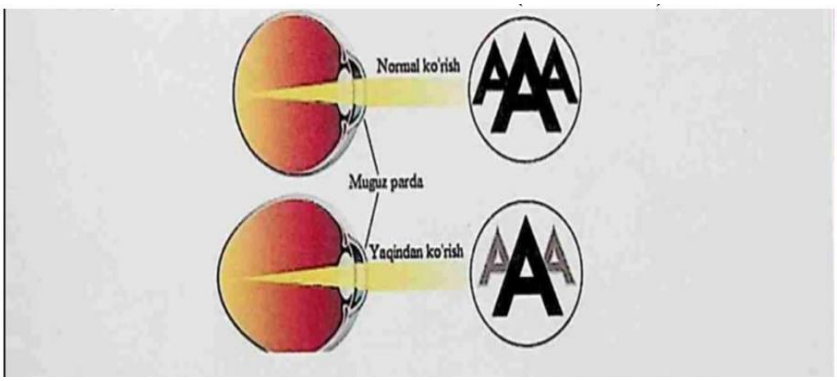
gavharining egriligi normal bo'lmasligi sabab bo'ladi.

Yaqindan ko'radigan (miopiya) odamning ko'z soqqasi cho'ziqroq shaklda bo'ladi (3-rasm). Shuning uchun uzodagi buyumlar tasviri ko'zning to'r pardasiga emas, balki undan oldinroqqa tushadi. Natijada uzodagi buyumlarning tasviri aniq ko'rinmaydi. Bu holat ko'z gavharining do'ngligi ortib ketishi oqibatida ham yuzaga kelishi mumkin. Miopiya holati tug'ma va hayotda orttirilgan bo'ladi. Yaqindan ko'ruvchi ko'zni korreksiyalash (tuzatish) uchun sochuvchi linza ishlatiladi



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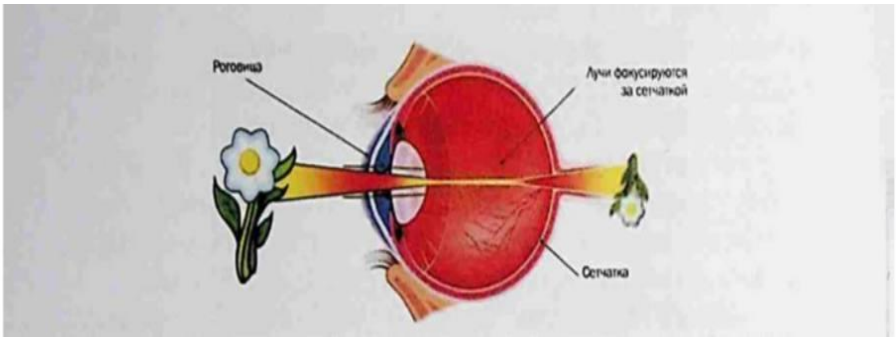
Uzoqdan ko'rish (gipermetropiya) asosan tug'ma bo'ladi.

Bunday odamlarda ko'z soqqasi qisqaroq bo'ladi. Bunda yaqindagi buyumlarning tasviri ko'z to'r pardasiga emas, balki uning orqasiga tushadi. Uzoqdan ko'rishning ikkinchi sababi ko'z gavhari do'ngligining kamayishidir. Bu ko'pincha keksalarda hayoti mobaynida sodir bo'ladi. Uzogdan ko'ruvchi ko'zni tuzatish uchun yig'uvchi linza ishlatiladi



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Astigmatizm - nuqtaviy bo'lmagan, buyumning bitta nuqtasiga tasvirning bir nechta nuqtalari to'g'ri keladi. Bu op tik sistemaning hunday kamchiligi-ki, unda serik yorug'lik to'lqini optik sistemadan o'ta turib, deformatsiyalanadi va sferikligini yo'qotadi (5-rasm).

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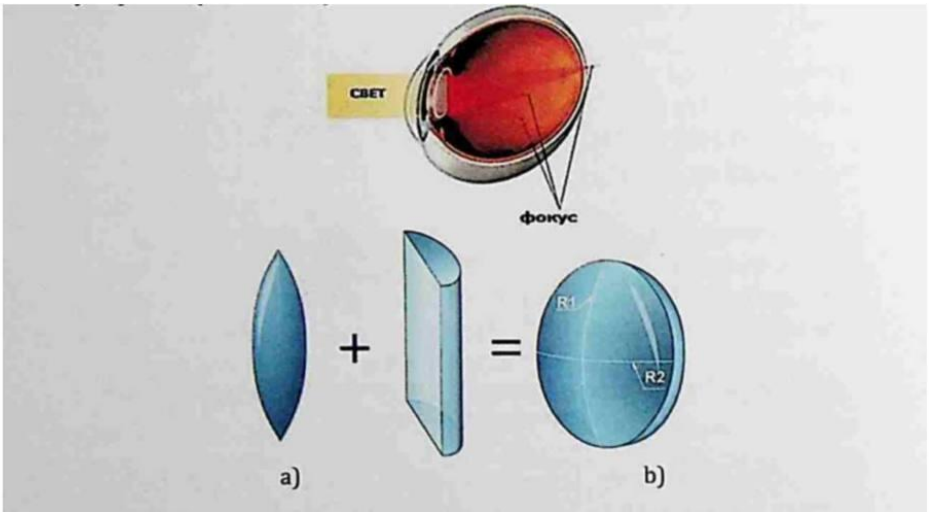
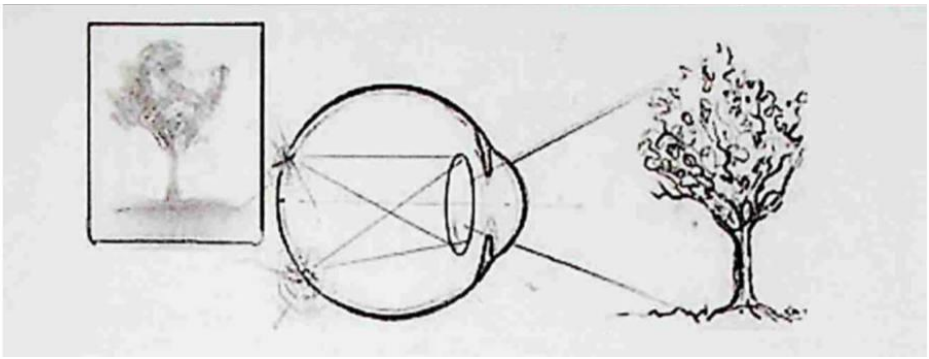
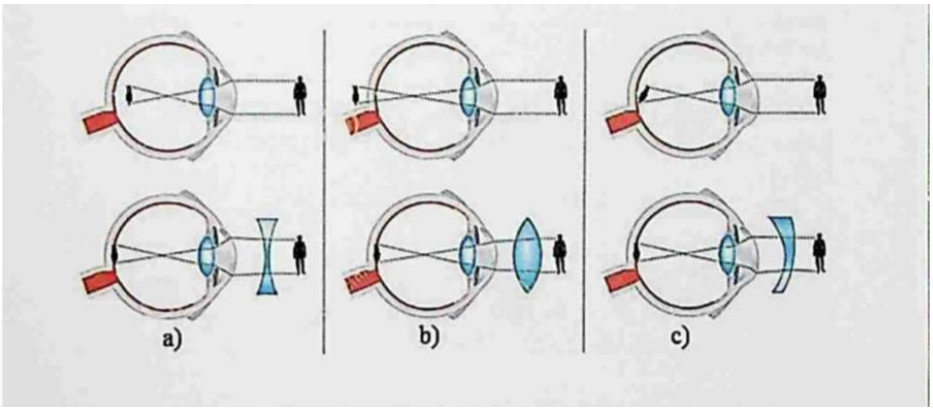




Astigmatizmni tuzatish uchun bir necha linzalardan iborat bo'lgan murakkab optik sistemalar hosil qilish, shu tufayli 50— 70° gacha bo'lgan burchak ostida tushgan nurlar yordamida yaxshi tasvirlar hosil qilish imkoniyatiga ega bo'linadi .



Ko'rish qobiliyatining yuqorida aytilgan buzilishlari sezilgan zahoti ko'z shifokoriga murojaat qilish zarur. Ba'zi odamlarda ko'zning ayrim ranglarni farqlash qobiliyati buzilgan bo'ladi. Ular qizil yoki yashil ranglarni farqlay olmaydi.

Bu kasallik daltonizm deb ataladi. Buning sababi ko'zning to'r parasida joylashgan rang sezuvchi kolbachasimon retseptorlarda ma'lum rang ta'sirida qo'zg'aladigan nervlar bo'lmasligidir.

Daltonizm kasalligi naldan-naslga o'tadi. Bu kasallik erkaklar orasida ko'proq uchraydi. Bunday odam transport vositalarini haydashi mumkin emas,

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chunki ular svetoforning qizil va yashil ranglarini farqlay olmaydi.

Ko'rish funksiyasi buzilishiga yuqorida aytilganlaridan tashqari, uning shoh qavatida oq parda hosil bo'lishi, ko'z shikastlanishi natijasida shoh avatining yaralanishi, ko'z gavharining kasallanishi (katarakta), ko'z ichidagi bosimning oshishi (glaukoma) kabi kasalliklar ham sabab bo'ladi.

Ko'z kasalliklarini o'rganuvchi oftalmologiya fani rivojlanishi natijasida oftalmolog olimlar murakkab operatsiya usullarini ishlab chiqdilar. Ular yordamida yuqorida ko'rsatilgan kasalliklarga chalinib, ko'rish qobiliyati pasaygan yoki butunlay yo'qolgan kishilar ko'pchiligining sogligini tiklashga muvaffaq bo'lindi.

Xulosa: Demak, odam ko’zi o’ziga xos optik asbob bo’lib,aloxida ahamiyatga ega ekan. Chunki ko’p optik asboblar ko’zning sezishiga mo’ljallangan. Xuddi shuningdek, ko’z tibbiyotdagilar uchun faqat funksional buzilishi va kasallanishi qobilyatiga ega bo’lgan a’zo xisoblanmay,balki ba’zi ko’zga taaluqli bo’lmagan boshqa kasalliklar to’risidagi axborot menda kam ekan.Shuning uchun ko’zni o’rganish va undagi kamchiliklar aniqlash texnikasi va texnologiyasi kundan-kunga rivojlanib bormoqda.

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Samarkand University named after Zarmed
Associate Professor **Rakhmatov Maksud**
Head of Clinical Studies
First-year student **Sevara Sharifova**

Abstract: *This article presents materials on the optical properties of the eye, its system and some structures, image formation on the retina, defects of the ocular optical system, and methods for their elimination.*

Keywords: *Optical system of the eye, retina, image of an object in the eye, myopia, hyperopia, astigmatism, visual acuity, cataracts.*

The human eye is a unique optical device that occupies a special place in optics. This is explained, firstly, by the fact that many optical devices are designed for visual perception, and secondly, by the fact that the human (and animal) eye, as a biological system that has evolved over time, generates several ideas for the design and improvement of optical systems within the field of bionics.

For doctors, the eye is not only an organ susceptible to functional disorders and diseases, but also a source of information about certain other diseases unrelated to the eyes.

Light entering the visual system is converted into an electrical impulse, which is transmitted through the optic nerves to the central nervous system of the brain.

Photoreceptors are extremely sensitive and convert even weak light falling on them into an electrical impulse. When exposed to light, certain biochemical reactions occur in the receptor cells, generating an action potential.

The eye not only receives electromagnetic waves but is also capable of distinguishing them. It determines the image and color of an object, even if it is located at a certain distance. Nature has achieved this through extensive evolution.

Some vertebrates also distinguish colors, like humans.

For example, horses, deer, and pigs distinguish only red and blue. Animals that hunt at night, such as cats and wolves, are colorblind. Animals cannot distinguish between ultraviolet and infrared rays. This is because wavelengths shorter than 290 nm barely reach the Earth from the Sun. Therefore, animals and humans have not developed organs that perceive this wavelength. However, the eye does not perceive ultraviolet rays with wavelengths significantly longer. This is because high-energy ultraviolet rays destroy the light-sensitive pigments in the eye.

Therefore, the lens and vitreous body are burned not only by ultraviolet rays but also by certain areas of the retina with a wavelength of approximately 400 nm. They also strongly absorb light. If the energy of these rays is high, then, if we take infrared rays, they are also emitted by the animal itself. At 37°C, maximum

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radiation corresponds to a wavelength of 9-10 μm. 1 cm² of an animal's body emits 50 mW of energy. This is much more than the energy incident on the eye from the sun.

Let's briefly review the structure of the human eye. The eyeball is the eye itself (Figure), 1) and is shaped like a slightly irregular sphere. In adults, the anterior-posterior diameter of the cornea averages 24.3 mm, the vertical dimension is 23.4 mm, and the horizontal dimension is 23.6 mm. The walls of the eye consist of three concentric layers—the outer, middle, and inner layers. The outer white layer—the sclera (1) at the front of the eye—continues into the transparent, convex cornea (2).

The thickness of the cornea is approximately 0.6 mm in the middle and up to 1 mm around the perimeter. In terms of its optical properties, the cornea is the most refractive part of the eye. It is, so to speak, the window through which light rays enter the eye. The radius of curvature of the cornea is 7-8 mm, and the refractive index of the material is 1.38. The outer layer of the cornea merges with the conjunctiva (3), which is covered by the eyelids.

The sclera is connected to the choroid (4), the inner surface of which is covered with dark pigment cells that prevent light scattering within the eye. At the anterior part of the eye, the choroid (5) merges with the colored membrane. This membrane has a round opening—the auricle (6). The pupil opens from the inside of the eye directly through the iris (7), a transparent and elastic body resembling a biconvex lens. The diameter of the iris is 8-10 mm, the radius of curvature of the anterior surface is on average 10 mm, and the radius of the posterior curvature is 6 mm. The refractive index of the iris is slightly greater than 1.4.

Between the cornea and the iris is the anterior chamber (8), filled with aqueous humor, a fluid with optical properties similar to water. From the iris to the back wall of the eye

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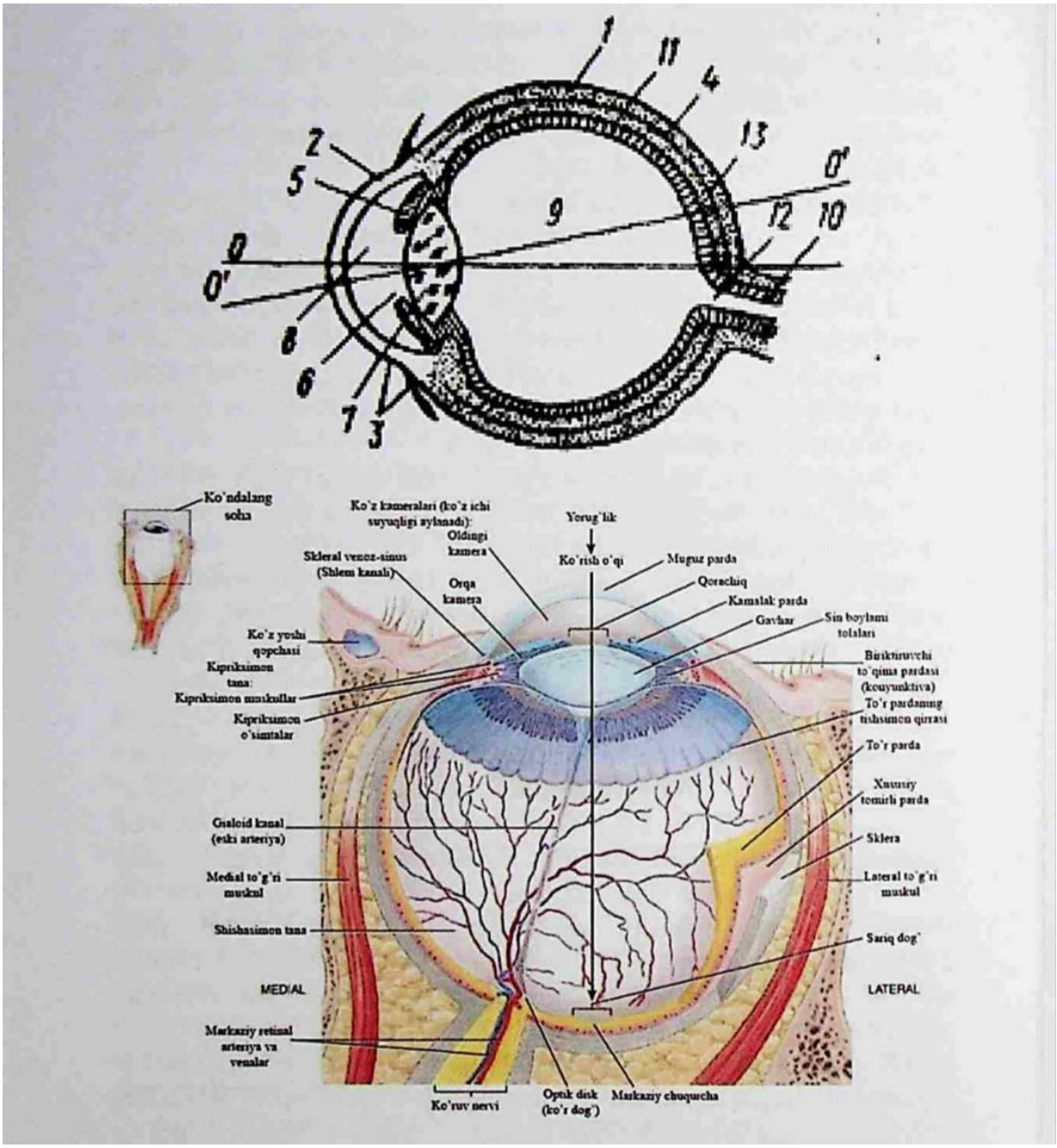

1-(Figure)

The use of the above or drawn elements mainly belongs to the light-receiving apparatus. 10 optic nerves 10 enter the eyeball or wall and, as you know, pass to the retina or the light-receiving apparatus (receptors) 11. In order for the retina to consist of several layers, the thickness of the layers and their sensitivity to light are not the same, light-sensitive visual cells of various shapes and sizes are located in it. Their elongated ends are called rods, and their cone-shaped ends are called cones. Rods are 63-81 μm long, 1.8 μm in diameter, and tubules are 35 μm and 5-6 μm. There are 130 million sticks and 7 million sausages in the eyeball of a person.

There is a blind spot in the eye where the optic nerve enters.

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In the middle of the prostate, near the edge, there is a yellow tube, the most sensitive to light, with a diameter of 0.4 mm from its central part.

Sausages and sticks are evenly cut on a griddle. Sausages are located mainly in the middle part of the proshchaet, in the yellow spot, only sausages are in the center of the yellow spot, and only sticks are located on the edges of the chtoby proshchaet.

First, let's consider the properties of the light-transmitting apparatus of the eye.

The eye can be imagined as a centralized optical system consisting of the cornea, aqueous humor and the iris (four refractive surfaces) and bounded in front by air and in between by the vitreous body.

The main optical axis 00 (Fig. 1) passes through the geometric marks of the cornea, pupil and iris. In addition, there is also the visual axis 00' of the eye, which determines the direction of light perception and passes through the centers of the iris and the macula, the angle between the optical and visual axes is approximately 5°. Figure 2 shows the foci, principal points, planes and nodal points for an average normal eye (distances are given in millimeters).

For simplicity, this system is often replaced by the reduced eye, i.e., a lens surrounded by a liquid with a refractive index h = 1.336 on the object phase side.

In one of the proposed eye models, the only major plane is located at a distance of 1.6 mm from the anterior surface of the cornea, the nodal points coincide and are located at a distance of 7.2 mm from the corneal surface.

The main refraction of light occurs at the outer edge of the cornea, the optical power of the entire cornea is approximately 40 diopters, the lens is approximately 20 diopters, and the entire eye is approximately 60 diopters. Figure 2

Objects at different distances should form images of the same clarity on the retina. To achieve this, as can be seen from formula (26.5), either the distance a2 between the main plane and the retina must be changed to the same value as in cameras, or the curvature of the lens, and hence the focal lengths F1 and F2, must be changed. The second case is realized in the human eye.

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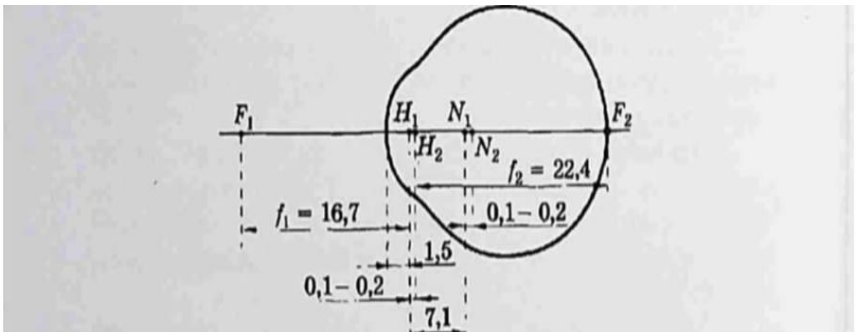

The ability of the eye to adapt to such a clear view of objects at different distances - "adjustment to sharpness" - is called accommodation. If the object is at infinity, its image in the normal eye is directly on the retina. At this time, the lens is accommodated to infinity and its optical power is minimal. If the object approaches the eye, then the curvature of the lens increases, the closer the object is, the greater the optical power of the eye, its changes are in the range of 60-0 diopters.

In a healthy adult, accommodation occurs harmlessly when the object approaches the eye at a distance of 25 cm, and since the eye is accustomed to seeing objects at hand, it accommodates more than anyone else, especially at this distance, therefore this distance is not the best viewing distance.

To see objects that are even closer, the accommodative apparatus must be strained. With an eye that can still provide a clear view of the retinal image, the object is not in the near field of view (near field of clear vision). As we age, the distance to the near field of view of the eye increases, that is, by accommodation.

The size of the image on the retina depends not only on the size of the object, but also on its distance from the eye, that is, on the visibility of the object. Accordingly, the relation for vision is introduced. The rays that emerge from the edge points of the object and pass through the corresponding nodal points are the exterior angles (Fig. 3). As can be seen from the figure, firstly, objects of different KM and QP can have the same visual ß, it is possible to see, vision can fully clearly determine the size of the image on the retina.

To describe the resolution of the eye, it is taken from the smallest angle at which the human eye can still distinguish two points of an object.

This angle is equal to 1', which corresponds to a distance of 70 m between the points at the best visual distance. In this case, the size of the image on the retina is 5 μm, which is equal to the average distance between two cones on the retina. For this reason, if the image of two points occupies a line on the retina shorter than 5 μm, then such points are not visible, that is, the eye cannot distinguish them.

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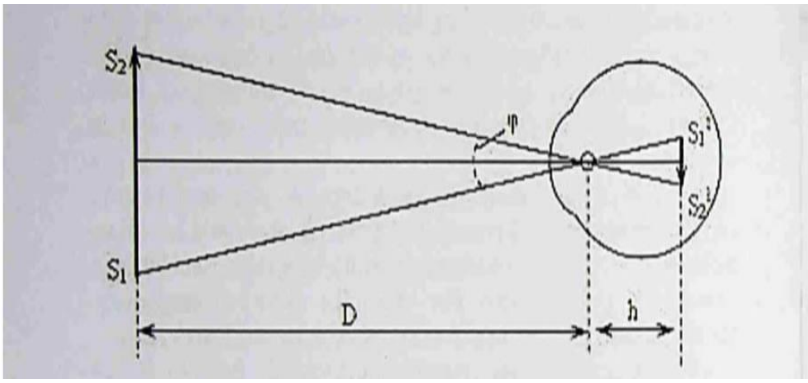

Figure 3. Formation of an image on the retina

Even when the limitations caused by light diffraction are taken into account, the smallest visual acuity is obtained in this way. The fact that "nothing is superfluous" in nature is surprising, the number of cones per unit area of the retina corresponds to the limiting import of geometric optics.

The resolving power of the eye is assessed by visual acuity. The norm of visual acuity is taken as "one", in which case the smallest visual field is equal to 1'.

If the patient's smallest visual field is equal to 4', his eye has an acuity of 1:4 = 0.25.

A certain room person can resolve smaller sizes than the eye fits into an angle of 1'. For example, the displacement of moving objects is felt when it reaches 20" in an arc, and the displacement of one of the two lines is known when the external angle is 12".

In physical measurements, devices (potentiometers, bridges) are often used whose arrow should not move from the zero level (line) of the scale. Due to the ability of the eye to perceive the displacement of small lines, with such an attempt, the distance between the lines is much more accurate than with a single arrow.

DEFECTS IN THE OPTICAL SYSTEM OF THE EYE AND THEIR ELIMINATION

Some defects are inherent in the optical system of the eye.

In the absence of accommodation, the back focus of the normal eye coincides with the retina, such an eye is called an emmetropic eye, and this condition is not met.

The most common forms of ametropia are nearsightedness (myopia) and farsightedness (hyperopia). This is caused by the shape of the eyeball, the normal curvature of the iris or the cornea. A person with nearsightedness (myopia) has an elongated eyeball (Figure 3). This causes the image of objects in the distance to focus on the retina, rather than on it. The image of objects in the distance is not clearly visible. This condition can also lead to an increase in the curvature of the eyeball. Myopia is congenital and acquired during life. To correct nearsightedness, a convex lens is used.

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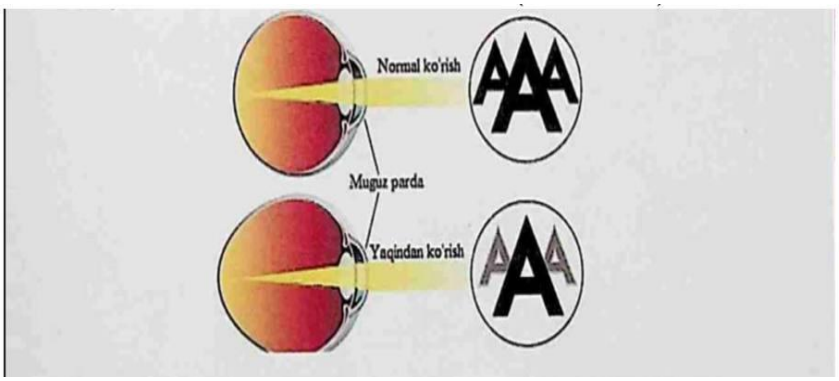
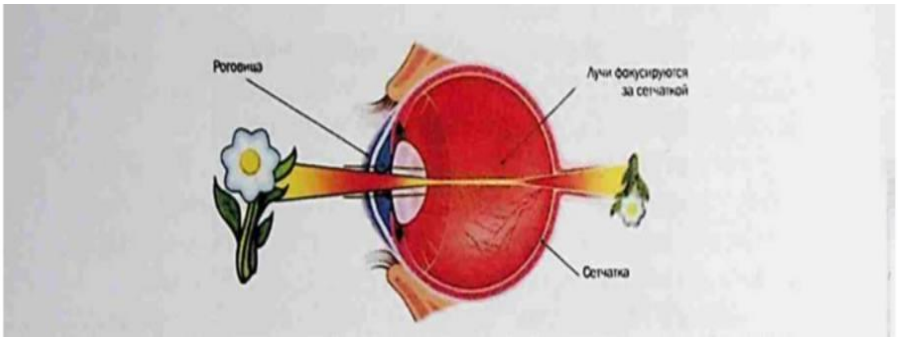
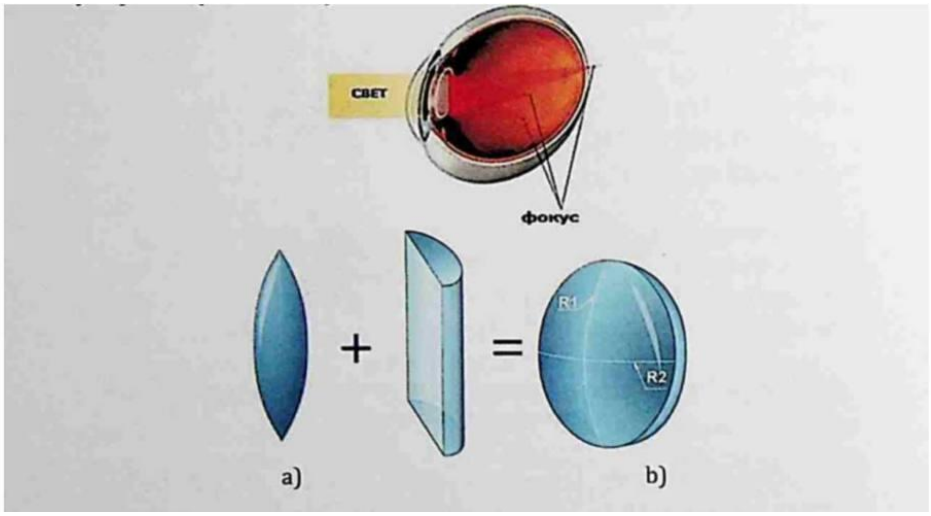


Farsightedness (hyperopia) is mostly congenital.

In such people, the eyeball is shorter. In this case, the image of nearby objects falls behind the retina, not on it. The cause of farsightedness is a decrease in the curvature of the eyeball. This often happens in the elderly. A converging lens for the farsighted eye



Astigmatism is a non-point, multiple image points coincide at a single point on the object. This is a defect of the optical system in which a spherical light wave, passing through the optical system, is deformed and loses its sphericity (Figure 5).



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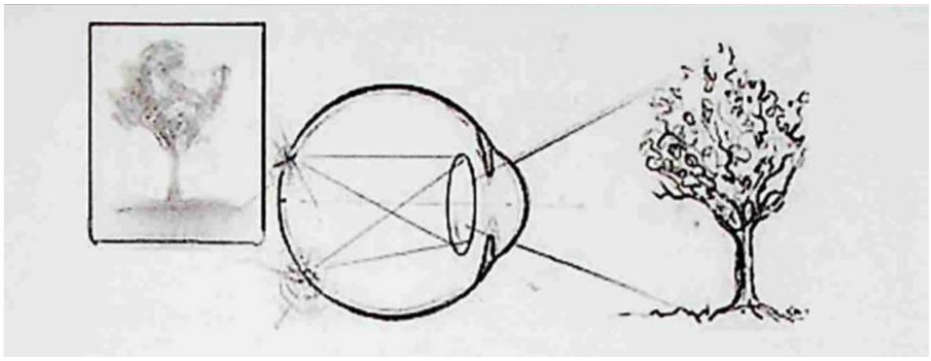
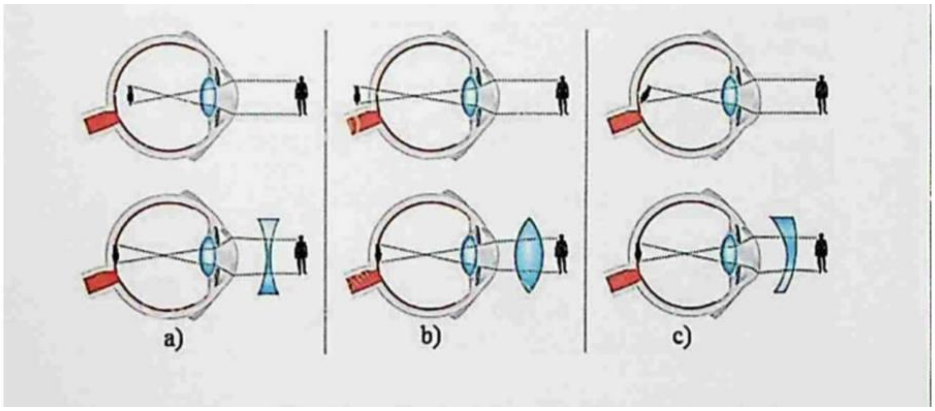


Astigmatism is corrected by a complex system of lenses consisting of several chambers, which allows for the formation of good images with rays incident at an angle of 50-70°.



As soon as the above-mentioned vision disorders are noticed, it is necessary to consult a doctor. Some people have difficulty distinguishing certain colors. They cannot distinguish between red and green.

This disease is called color blindness. The reason for this is that the color-sensitive cone-shaped receptors located in the retina of the eye are activated by certain colors.

Color blindness is passed down from generation to generation. It is more common among men. Such a person cannot drive a vehicle, because they cannot distinguish between red and green lights.

In addition to the above, the appearance of a white film on the surface of the eye, the formation of a cataract, and other eye diseases such as glaucoma can also cause visual impairment.

The science of ophthalmology, which studies eye diseases, has developed complex surgical methods. They have managed to restore the health of many people who have suffered from reduced or completely lost vision by developing the above-mentioned devices.

Conclusion: So, the human eye is a unique optical device, which has a separate cover. A lot of optical power is perceived by the eye because. for help, for those in eye medicine, only the account of a member who has the ability to provide services and get sick, perhaps some other

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correct information that does not apply to the eye is lacking.

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