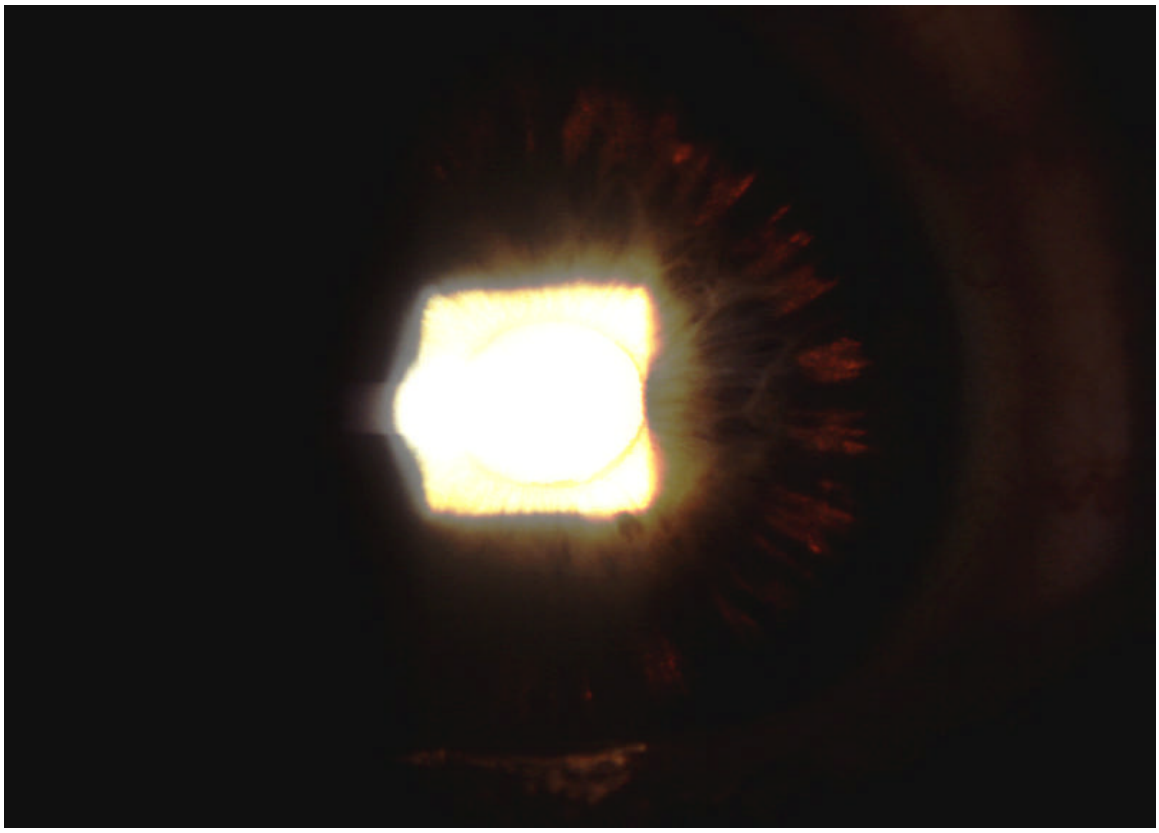
GLAUCOMA

PIGMENT DISPERSION



Q: Picture with spoke transillumination defects (mid-peripheral iris TI defects) shown (see above).

- What other associations/findings are there?
- Are there any retinal findings?
- How would you manage it?

A:

- Triad—K-spindle, TI defects, TM pigmentation. Myopia, young age, concave iris, posterior iris insertion. PDS same sex distribution, but PG 3x more common in men.
- Retinal findings are increased incidence of lattice degen, and breaks and increased incidence of RD 6-8%.
- Management – Ocuserts, consider AL/Yag PI, other antiglaucoma drops consider ALT after.

INFORMATION:

- PDS and pigmentary glaucoma (PG) are characterized by disruption of the iris pigment epithelium (IPE) and deposition of the dispersed pigment granules throughout the anterior segment.
- The classic diagnostic triad consists of corneal pigmentation (Krukenberg spindle; slit-like, radial, mid-peripheral iris transillumination defects, and dense trabecular pigmentation.)

- The iris insertion is typically posterior and the peripheral iris tends to have a concave configuration. The basic abnormality in this hereditary disorder remains unknown.

including bilaterality, frequent association with myopia, greater incidence in men than in women, and a relatively young age of onset.

pathogenesis to involve mechanical damage to the IPE during rubbing of the posterior iris against the anterior zonular bundles during physiologic pupillary movement. Subsequently, the autosomal dominant inheritance, natural history, reversibility, and more precise therapeutic approaches have become increasingly delineated. Ultrasound biomicroscopic studies are presently revealing new insights into the pathophysiology of PDS.

CLINICAL FINDINGS

A. ANTERIOR SEGMENT

- midperipheral, radial, slit-like pattern of transillumination defects seen most commonly inferonasally and more easily in blue eyes than in brown ones. Although the defects can sometimes be seen by retroillumination, they are more easily detected by a dark adapted examiner using a fiberoptic transilluminator in a darkened room. Infrared videography provides the most sensitive method of detection.
- Pigment particles deposited on the iris surface tend to aggregate in the furrows. Rarely, this pigment can be dense enough to darken the iris or to cause heterochromia when involvement is asymmetric
- Iris vascular hypoperfusion on fluorescein angiography has been reported.
- Anisocoria may occur with asymmetric involvement, the larger pupil corresponding to the eye with greater pigment loss from the iris.
- Corneal endothelial pigment generally appears as a central, vertical, brown band (Krukenberg spindle), the shape being attributed to aqueous convection currents.
- Coincident PDS and megalocornea has been reported, as have subluxated lenses.
- The anterior chamber is deeper both centrally and peripherally than can be accounted for by sex, age, and refractive error.
- The angle is characteristically widely open, with a homogeneous, dense hyperpigmented band on the trabecular meshwork.
- Pigment may also be deposited on Schwalbe's line.
- The iris insertion is posterior and the peripheral iris approach is often concave.
- The iris is most concave in the midperiphery.
- In younger patients, the scleral spur may be poorly demarcated, blending with the ciliary face due to pigment deposition on these structures.
- Pigment may be deposited on the zonules and on the posterior capsule of the lens, where it is apposed to the anterior hyaloid face at the insertion of the posterior zonular fibers.

B. POSTERIOR SEGMENT

- PDS is associated with a high incidence of retinal detachment.
- Most detachments occur in phakic men who are not highly myopic.
- Miotics have been incriminated in precipitating these.
- It is significant that the **incidence of retinal detachment in PDS is 6% to 8%** independent of miotic treatment, and when detachment is associated temporally with miotics, a preexisting lesion was most likely present.
- Lattice degeneration is commonly found in myopes and may be hereditary. Its incidence appears to be higher for all degrees of myopia in patients with PDS than in the general population.
- Despite the fact that comparable prevalences of lattice degeneration in blacks and whites have been demonstrated at autopsy, PDS and retinal detachment are both uncommon in blacks.
- It may be preceded or caused by chronic, localized vitreoretinal traction, which is exaggerated around the margins of the lesion.

CLINICAL CORRELATIONS

A. HEREDITY

- A strong pattern of autosomal dominance, with phenotypic onset probably beginning in most persons in the mid-20s.
- That Caucasians are almost exclusively affected is also consistent with a genetic origin.

B. GENDER

- Men and women are equally affected by PDS, women having predominated in some series and men in others.
- However, men develop glaucoma about 3 times as often as women and at a younger mean age.
- No difference in age at diagnosis of PDS between men and women, but men were significantly younger than women at the time of diagnosis of PG. No population based study has yet been performed.

If myopia is the major determinant of phenotypic expression, then one would expect an equal incidence of men and women, since the prevalence of myopia in the United States is similar between men and women. Why then do more men develop glaucoma and why do women appear to develop it at a somewhat older mean age? It is possible that female hormones exert a protective effect against the development of elevated IOP.

C. REFRACTIVE ERROR

- About 60-80% of patients with PDS and PG are myopes and 20% are emmetropes (-1.00 to +1.00 diopters). In earlier series which reported about 10% of patients to be hyperopes, there appears to have been some confusion between PDS and exfoliation syndrome, particularly as the hyperopes in these series tended to be older and to be women.

- Eyes with PG are significantly more myopic than those with PDS and the higher the myopia, the earlier is the age of onset of glaucoma.

D. ASYMMETRIC INVOLVEMENT

- Since PDS is a bilateral disorder, asymmetric involvement requires explanation. A second disorder may make one eye worse.
- The most common cause in older patients appears to be the development of exfoliation syndrome in one eye in patients who had had PDS or PG glaucoma in earlier life.
- Angle recession in one eye has also been reported.
- It is also possible for one eye to have a second disorder which reduces the severity of PDS, such as unilateral traumatic cataract extraction in youth prior to the onset of pigment dispersion or development of unilateral cataract during the pigment dispersion phase, which decreases iridozonular contact by causing pupillary block. Horner's syndrome may achieve the same effect. Also anisometropic patients with greater involvement in the more myopic eye.

NATURAL HISTORY

A. ACTIVE PHASE

- The mean age of onset of PDS remains unknown, but is probably in the mid-20s.
- The development of PDS later in life is unlikely because of gradual lens enlargement and loss of accommodation.
- The phenotypic expression of PDS varies widely. It is not known whether the variability in phenotypic expression is hereditary, environmental, or a combination of both. For instance, the concavity due to iris position and size (genetic) could be affected by the cumulative amount of accommodation (environmental).

B. REGRESSION PHASE

- The severity of involvement of both PDS and PG decreases in middle age when pigment liberation ceases, at least in the majority of patients. Decreased pigment in the trabecular meshwork in 10%, pigment could pass out of the meshwork with age. Transillumination defects may disappear, most likely by migration of pigment epithelial cells adjacent to the defects. The IOP may return toward normal. Older patients presenting with glaucoma may have only very subtle manifestations, if any, of PDS, and may be misdiagnosed as primary open-angle glaucoma or low-tension glaucoma.

C. LOGIC OF TREATMENT

- The development of relative pupillary block secondary to an age-related increase in lens thickness and loss of accommodation with the onset of presbyopia are two processes which presumably lead to the cessation of pigment liberation in middle age.
- By eliminating the iris concavity and iridozonular contact, miotic therapy may prevent progression of the disease and the development of glaucoma by immobilizing the pupil and may allow previously existing damage to reverse more readily. Since

most PDS patients are young and cannot tolerate pilocarpine drops because of induced myopia and accommodative spasm, pilocarpine Ocuserts have proven to be the best available for of miotic therapy.

- The success rate of argon laser trabeculoplasty (ALT) in PG is greater in younger patients than in older ones and decreases with age.
- Pigment in younger patients is largely in the uveoscleral and corneoscleral meshworks, whereas in older patients, it if primarily localized to the juxtacanalicular meshwork and the back wall of Schlemm's canal.
- A larger portion of patients fail within a shorter period of time compared to POAG patients. Initially successful trabeculoplasty may be followed by a sudden, late rise in IOP, similar to that seen in exfoliative glaucoma.
- Patients in the pigment liberation stage who undergo ALT should be maintained on miotics or undergo laser iridotomy after ALT to prevent further contact between the iris and zonules.

MANAGEMENT

- Since the degree and stage of pigment liberation, intraocular pressure, and extent of glaucomatous optic neuropathy vary among individuals, each must be evaluated to determine the proper course.
- Beta-adrenergic antagonists. The mainstay of initial medical therapy for PG continues to be aqueous suppression with a topical beta-blocker, primarily because of the relatively easy dosing schedule and minimal side effects.
- Parasympathomimetics. In theory, therapy directed at increasing relative pupillary block should relieve iridozonular contact and diminish pigment liberation. The relief of iridozonular contact following miotic therapy has been demonstrated with ultrasound biomicroscopy. However, strong miotics in young individuals are rarely tolerated because of the associated spasm of accommodation and blurring of vision. Low-dose pilocarpine in the form of Ocuserts often provide enough miosis to create pupillary block, without disabling adverse effects. A careful peripheral retinal examination should be performed before and after the institution of or change in miotic therapy because of the higher incidence of retinal breaks and detachment in these patients.
- Alpha-adrenergic agonists. Alpha-agonists are useful in PG, but the development of allergy in up to 50% of patients precludes their long-term use in many individuals.
- Carbonic anhydrase inhibitors. Topical carbonic anhydrase inhibitors are useful agents for PG and are generally well-tolerated. Systemic agents should be reserved for particularly difficult circumstances or when the risks of surgery are unacceptably high.
- Prostaglandin analogues. This new class of medications, which lower IOP by increasing uveoscleral outflow, are effective in PG and offer the advantage of once-daily administration. The iris surface color change which may occur during therapy appears to involve increased melanin production by iris melanocytes and is not known to affect the iris pigment epithelium or result in pigment dispersion.
- Alpha-adrenergic antagonists. Theoretically, a drug that would constrict the pupil and make the peripheral iris taut might decrease iridozonular rubbing and eliminate

pigment accumulation in the meshwork. An alpha-adrenergic blocking agent such as thymoxamine hydrochloride, which constricts the pupil but does not affect accommodation or aqueous dynamics, could be beneficial to such patients. Thymoxamine hydrochloride is not yet approved for this purpose and is unavailable for general use. In addition, in its present formulation, the ocular irritation that the drug causes makes it unlikely that patients would tolerate it.

SURGERY

- Laser trabeculoplasty. Argon laser trabeculoplasty may be offered as a treatment in the management of uncontrolled PG. Although the initial result is often good, a larger proportion of patients can lose control of IOP when compared to primary open angle glaucoma patients, and the loss of control can occur in less time. In contrast to other forms of open angle glaucoma, younger patients appear to respond better to trabeculoplasty than do older individuals.
- Laser iridectomy. Laser iridectomy eliminates the iris concavity present in PDS by permitting equalization of pressures between the anterior and posterior chambers. This causes the iris to become flat, thereby decreasing iridozonular contact. Anecdotal evidence suggests that this can prevent continued pigment liberation, result in a reversal of trabecular pigmentation, and subsequently, lowering of IOP. Although this approach is theoretically sound, laser iridectomy should be used with caution because there is a paucity of data regarding the long-term efficacy of this procedure.

A. FILTERING SURGERY

- The surgical management of patients with PG follows the same principles and considerations used in the management of primary open angle glaucoma. The appearance and change in the optic nerve along with visual field defects should be the principal guidelines used in deciding whether surgery is needed. Most patients respond well to standard filtration operations, although antifibrosis agents may be indicated to achieve a low target pressure or for reoperation.

SUMMARY

In sum, PDS is an inherited disorder of abnormal iridozonular contact which is exaggerated by physiologic pupillary movement and accommodation. This contact results in disruption of the IPE cells and liberation of pigment, which is deposited on structures throughout the anterior segment. Pigment liberation can be triggered by exercise and by pupillary dilation. Myopia predisposes to the phenotypic expression of the disorder, which affects men and women equally, but men develop glaucoma 2-3 times as often as women and at an earlier age. Pigment dispersion begins in the teens or twenties and continues until about the mid-40s in most people, at which time a combination of relative pupillary block and presbyopia lead to gradual cessation of pigment liberation. After this, the visible signs of pigment loss can reverse and IOP control can improve. Older patients

presenting for the first time with glaucomatous damage and normal IOP may be misdiagnosed as having normal-tension glaucoma.

Anatomically, the iris seems excessively large for the eye and is posteriorly inserted, resulting in a characteristic concave midperipheral configuration, iridozonular contact, and abnormally extensive iridolenticular contact. When blinking is inhibited, the iris assumes a convex configuration which is immediately reversed upon blinking, suggesting that the act of blinking acts as a mechanical pump to push aqueous humor from the posterior to the anterior chamber. Once in the anterior chamber, aqueous backflow is prevented by the abnormal iridolenticular contact, which produces a reverse pupillary block, further enhancing the iris concavity.

Treatment should begin early in order to prevent the development of glaucomatous damage and should be designed to prevent progression of the disease rather than merely lower IOP. Miotic treatment produces a convex iris configuration, completely inhibiting pigment liberation, while laser iridotomy produces a planar configuration and may not completely inhibit pigment liberation. Aqueous suppressants theoretically may negatively impact the course of the disease. Argon laser trabeculoplasty produces better results in younger patients than older ones because of the location of the pigment in the trabecular meshwork.

Persons with pigment dispersion also have an abnormally high incidence of lattice degeneration of the retina and retinal detachment. Any hypothesis regarding the origin of this disease must take this into account. It must also provide a reason why many myopes without PDS have an iris concavity which also increases with accommodation. An abnormal persistence of the marginal bundle of Druault might lead to an abnormality of zonular position. The responsible gene should also affect the size of the iris and perhaps susceptibility of the IPE cells to disruption. A gene affecting some aspect of the development of the middle third of the eye early in the third trimester appears at the present time to be the most likely cause.

Figure 1. Krukenberg spindle.
Liberated pigment granules are borne by aqueous currents and deposited on the structures of the anterior segment. The vertical accumulation of these pigment granules along the corneal endothelium is known as Krukenberg's spindle). The spindle tends to be slightly decentered inferiorly and wider at its base than its apex.

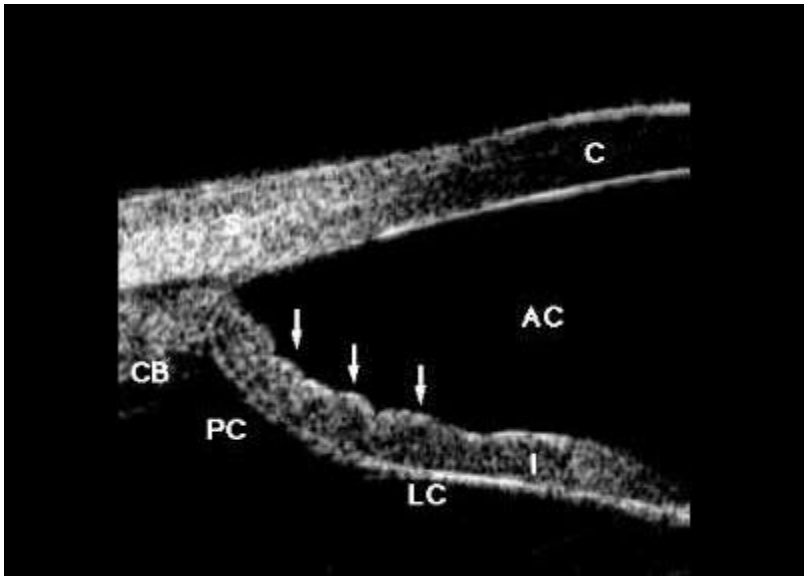


Figure 2. Ultrasound biomicroscopy in PDS.
The iris concavity in PDS has been investigated using high frequency, high resolution ultrasound biomicroscopy. Ultrasound biomicroscopy is an innovative diagnostic tool which employs high frequency ultrasound to permit high resolution in vivo imaging of the anterior segment. It has been particularly useful in the evaluation of the structures surrounding the posterior chamber. The iris (I) is bowed posteriorly, towards the zonules and posterior chamber (PC). The ciliary body (CB), cornea (C), anterior chamber (AC),

and lens capsule (LC) are visible. Although most young individuals with undisputed PDS (young age, zonular pigment dispersion, increased meshwork pigmentation, myopia) have a demonstrable iris concavity which can be measured during ultrasound biomicroscopy, the prevalence of iris concavity at the time of initial diagnosis has not been evaluated in a large study.

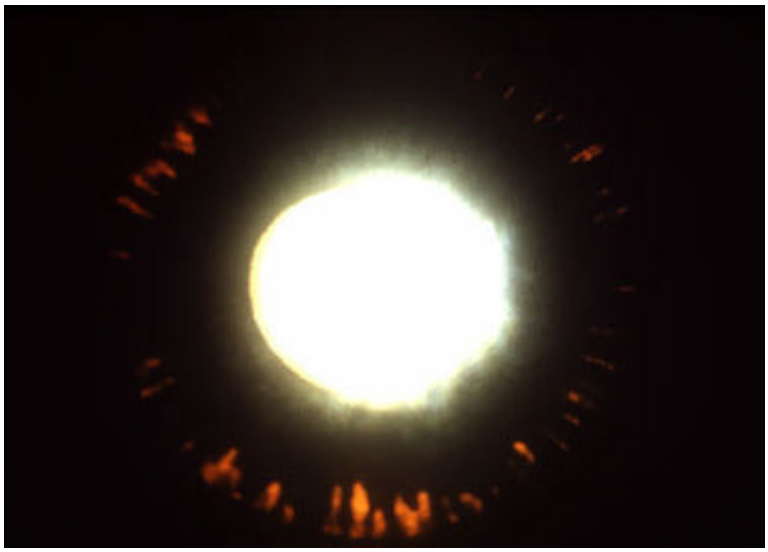


Figure 3. Iris transillumination.

Movement of the posteriorly bowed, concave iris along the anterior zonular bundles causes a disruption of the iris pigment epithelium along the radial orientation of the zonular fibers which results in characteristic mid-peripheral, iris transillumination defects seen during slit-lamp examination. This finding is pathognomonic for zonular pigment dispersion and differentiates PDS from other glaucomas related to accumulation of pigment in the trabecular meshwork.

The width, length, and frequency of these defects varies among individuals and a high index of suspicion on the part of the examiner is often needed to make the diagnosis. It is best to search for iris transillumination defects prior to pupillary dilation by using a small slit beam in a darkened room. However, those patients who do not appear to have transillumination defects on retroillumination but have increased trabecular pigmentation, Krukenberg spindle, myopia or juvenile open angle glaucoma should be examined with scleral transillumination using a fiberoptic scleral transilluminator in a darkened room to facilitate detection. Pupillary dilation may prevent the detection of transillumination defects because of the compaction of the peripheral iris stroma.

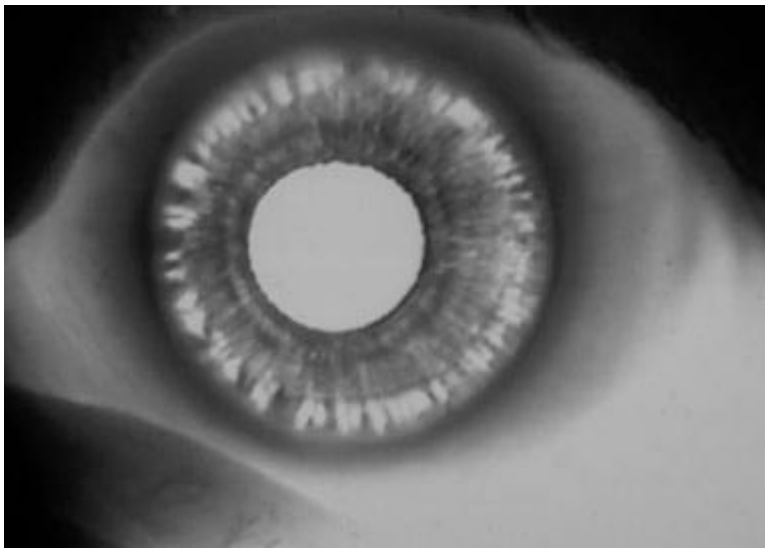


Figure 4. Infrared videopupillography.

The number of iris transillumination defects often corresponds clinically to the degree of anterior segment pigment liberation and elevated IOP, although this is not always the case. In eyes with asymmetric disease, the eye with the higher pressure is invariably the one with the greater pigment liberation.Some physicians have advocated the documentation of the numbers of transillumination defects as a means of the following the progression of the disease. Individuals in the pigment liberation phase of the disease typically have an increasing number of transillumination defects, whereas those individuals who are no longer actively liberating pigment may have defects which shrink in size or disappear. Although standard slit-lamp photography can be used to document the number of defects, infrared video pupillography may provide more accurate visualization

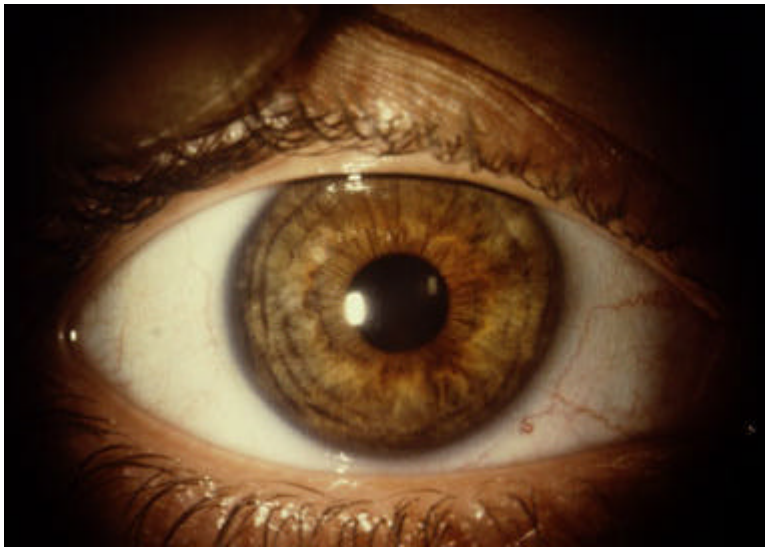


Figure 5. Iris surface pigmentation.

Pigment accumulation on the anterior surface of the iris often appears as concentric rings within the iris furrows. More diffuse pigmentation can cause a diffuse darkening of iris color, which is more apparent in lightly pigmented irides because of the degree of color

change. Asymmetry of pigment liberation may result in iris heterochromia, with the darker iris being the more affected side.

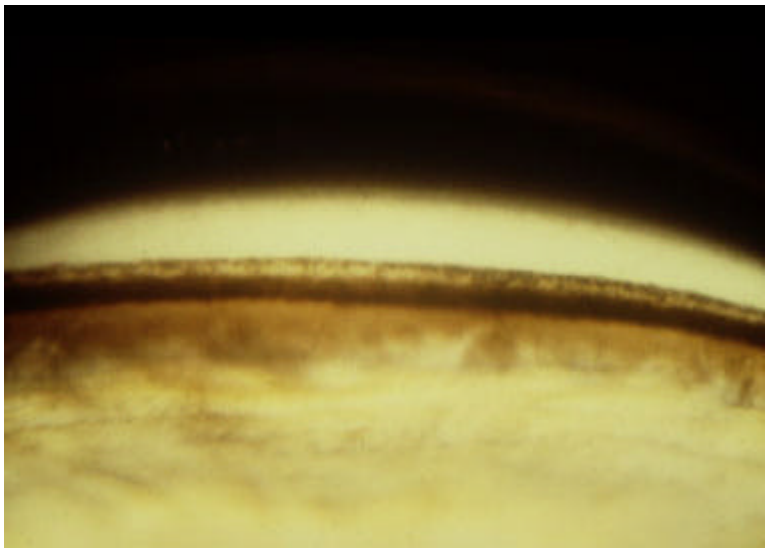


Figure 6. Trabecular pigmentation.
Increased trabecular pigmentation occurs in a wide variety of glaucomas. In PDS, the trabecular pigmentation is typically homogeneous in its distribution, unlike the variegated appearance associated with exfoliation syndrome, uveitis, or angle-closure glaucoma. The degree of pigmentation ranges from moderate to dense and is often quite striking. In some individuals the increased pigmentation may be limited to the posterior trabecular meshwork, while in others the anterior meshwork, Schwalbe's line, or peripheral cornea may be covered with dense pigmentation.

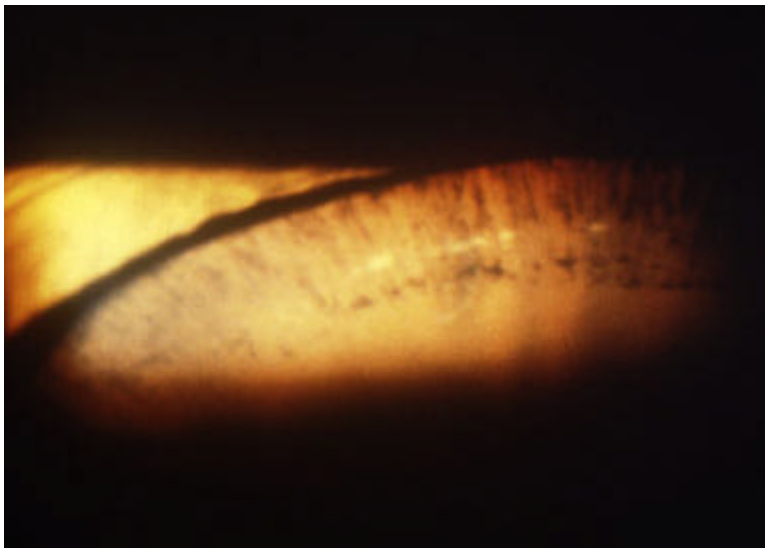
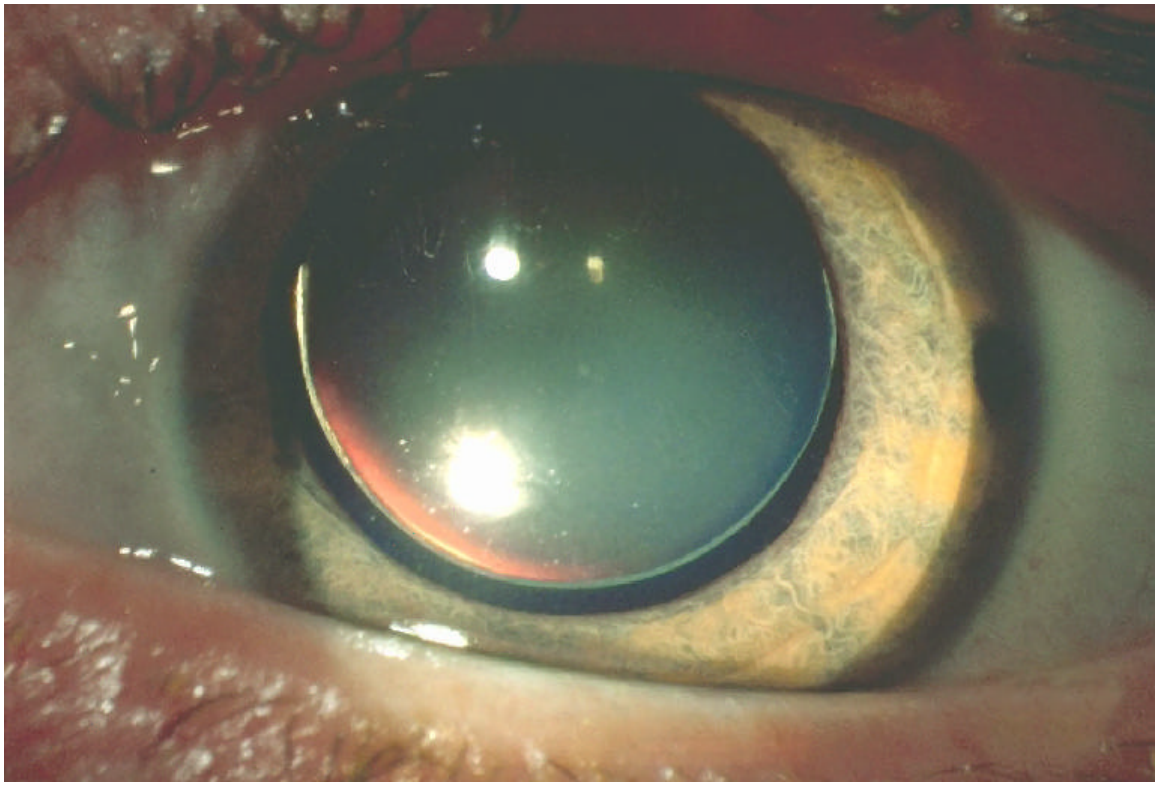


Figure 7. Lens pigmentation.
Pigment deposition on the zonular apparatus may allow visualization of the radial anterior zonules as they traverse the posterior chamber to the anterior lens surface. Since liberated pigment floats freely within the aqueous, some of the pigment granules may also move posteriorly behind the lens equator, where they accumulate at Weigert's

ligament, the region of contact between the anterior hyaloid face and the posterior lens capsule. Visualization of this circular ring or arc of pigmentation requires pupillary dilation and upon occasion, gonioscopy, and is considered pathognomonic for PDS, since it has not been identified in other disorders associated with pigment liberation in the anterior segment.

MICROSPHEROPHAKIA



Q:

- This person has high IOP, what is the Dx?
- How would you manage it?

A:

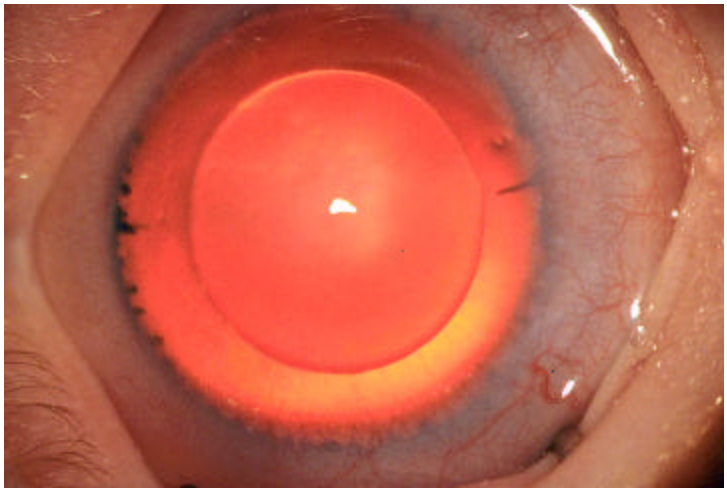
- Pupillary block glaucoma due to microspherophakia
- Place the patient in a supine position, and use mydriatic drops, miotics are contraindicated. Consider laser iridotomy, and do gonio for PAS.

- The dilated examination reveals the entire lens and supporting zonules to be within the pupillary space.
- Patients with microspherophakia frequently develop a pupillary block-type glaucoma caused by anterior prolapse of the lens.
- This commonly occurs at nighttime, causing pain and discomfort.
- The situation is usually relieved by placing the patient in a supine position, permitting the lens to fall back into the posterior chamber. However, progressive peripheral anterior synechiae may form.
- Microspherophakia is commonly associated with Weill-Marchesani syndrome, in which the lens is displaced superior temporally.
- Other features of this syndrome include small stature, brachydactyly, deafness, and a high degree of myopia.

Management

- Patients with microspherophakia should undergo gonioscopy to determine whether peripheral anterior synechiae are present.
- A peripheral laser iridotomy should be considered to prevent repeated attacks of pupillary block glaucoma and progressive closure of the filtration angle by peripheral anterior synechiae.
- The zonules are loose, and the lens may eventually disinsert, resulting in dislocation.
- If cataract surgery is undertaken, the surgeon should be prepared to suture the intraocular lens to the iris or sclera.
- An anterior chamber lens is usually contraindicated in these patients because of peripheral anterior synechiae.

ANIRIDIA



Q:

- What is the mechanism of glaucoma?
- What is the management/treatment?

A:

- Mechanism is associated with progressive contracture of the anterior chamber angle and closure of the trabecular meshwork by the residual iris.
- In older patients, filtration surgery is the procedure of choice. Goniotomy or trabeculotomies frequently do not work in older children because of the extensive angle-closure. In younger children, goniotomy should be attempted, if the anterior chamber angle is open.

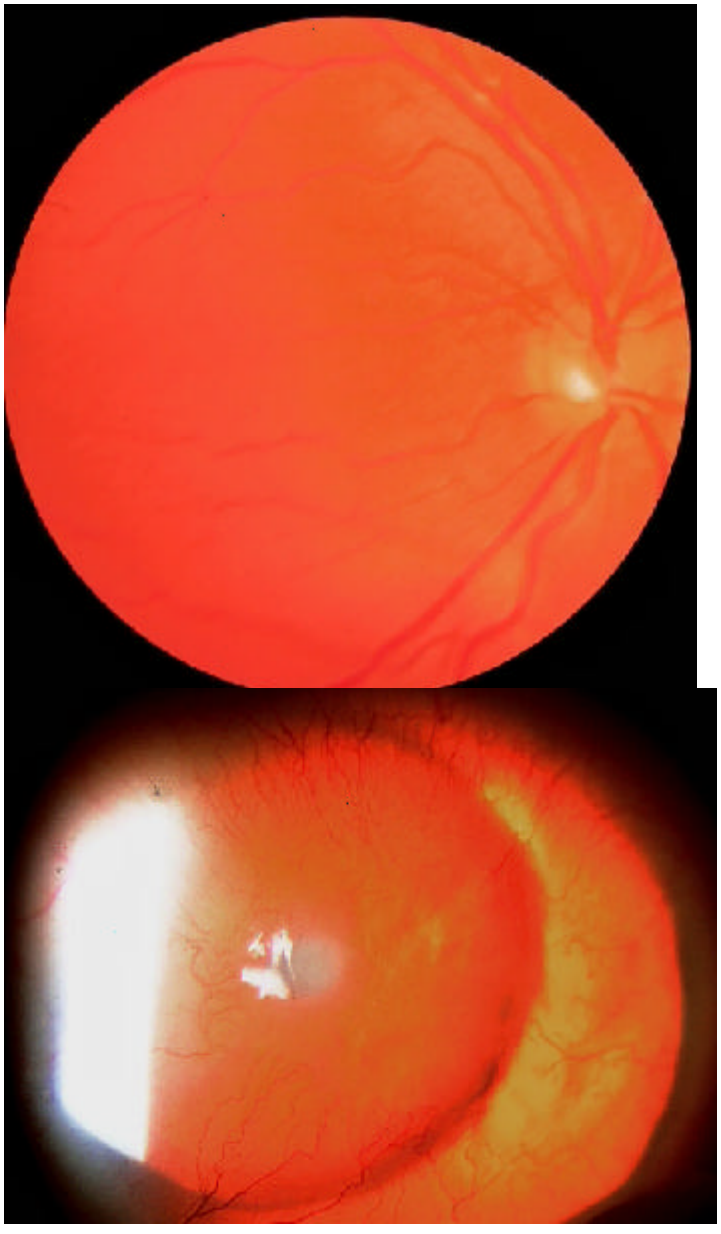
- The name aniridia suggests that the iris is absent, but in this disorder, the iris is always present but hypoplastic, often hidden behind the sclera on direct view, and visible only by gonioscopy.
- The condition is congenital, always bilateral, and often familial, transmitted in an autosomal dominant fashion.
- Two thirds of cases are dominantly transmitted with a high degree of penetrance
- Patients with the sporadic form of aniridia has a greatly increased chance of developing Wilms' tumor of the kidney. (20% risk in sporadic)
- However, only 1% of patients with Wilms' tumor have aniridia.
- The risk is increased further if the patient has genitourinary anomalies or mental retardation.
- . A deletion of the short arm of chromosomes 11 and 13 has been demonstrated in the association of Wilms' tumor and sporadic aniridia
- All patients with sporadic aniridia should have periodic ultrasound examinations of the kidney to detect such tumors early.
- Patients with aniridia commonly have a nonvascularized and nonprogressive pannus of the cornea.
- Typically, there is hypoplasia of the fovea with no well-defined umbo.
- As a result, the typical vision is about 20/200, although some may have better vision, and nystagmus is common.
- Optic nerve hypoplasia occurs in 75% of aniridic patients and may be related to poor macular development.
- These patients frequently have prominent deposits of the anterior lens capsule and cortical dot-like opacities.
- In a sense, aniridia is a progressive disease.
- Cataracts that are visually significant may develop in 50% to 85% of patients, and the lens may partially dislocate.
- A major problem is the development of glaucoma that is difficult to treat. (In greater than 50% and occurs in 2^{nd} or 3^{rd} decade).
- It is associated with progressive contracture of the anterior chamber angle and closure of the trabecular meshwork by the residual iris.
- Glaucoma may occur at a younger age without angle-closure, secondary to congenital abnormalities of the anterior chamber angle.
- In older patients, filtration surgery is the procedure of choice. Goniotomy or trabeculotomies frequently do not work in older children because of the extensive angle-closure. In younger children, goniotomy should be attempted, if the anterior chamber angle is open. Medical management should always be attempted because these patients do very poorly with surgery.
- In about the second decade of life, the epithelium of the cornea may begin to become loose and slough away.
- Other ocular abnormalities include microcornea, lens subluxation, choroidal colobomas, and strabismus.

WAGR Syndrome -- Wilms'-aniridia-gonadoblastoma-retardation complex

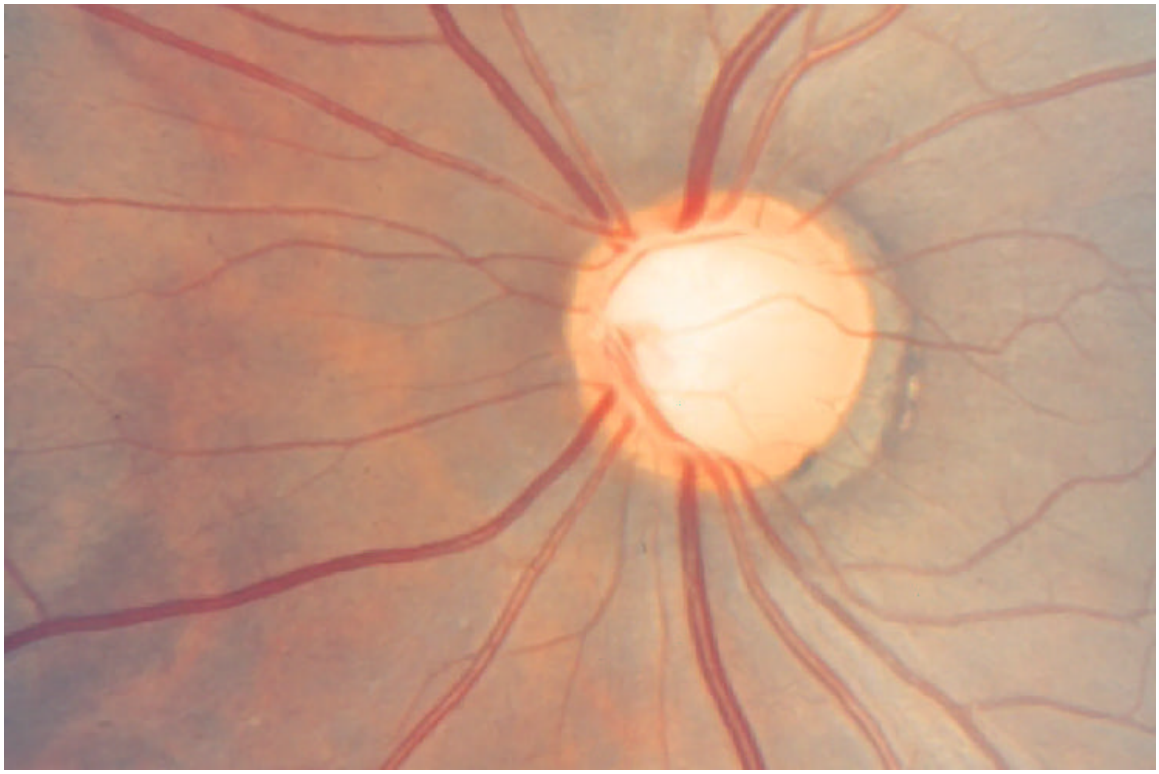
- Deletion of band p13 of chromosome 11 produces the WAGR syndrome consisting of
- Wilms' tumor, sporadic aniridia, genitourinary malformations, and mental retardation.
- Wilms' tumor is an embryonic neuroblastoma and is the most common malignant renal tumor in both children and adolescents.
- About 6% of all primary renal tumors regardless of age are Wilms' tumors.
- Although most Wilms' tumors occur as an isolated sporadic event, there are several syndromic associations of Wilms' tumor, including WAGR syndrome.
- A Wilms' tumor suppressor gene has been localized to band p13 of chromosome 11 near the gene responsible for sporadic aniridia.
- Sporadic aniridia is present in 1% of children with Wilms' tumor and results from a 11p13 deletion that includes both genes.
- The Wilms' tumor suppressor gene appears to play an important role in the normal development and maturation of the kidneys and gonads.
- Any newborn with nonfamiliar aniridia should be examined by a geneticist and followed by a medical team familiar with detection and management of Wilms' tumor

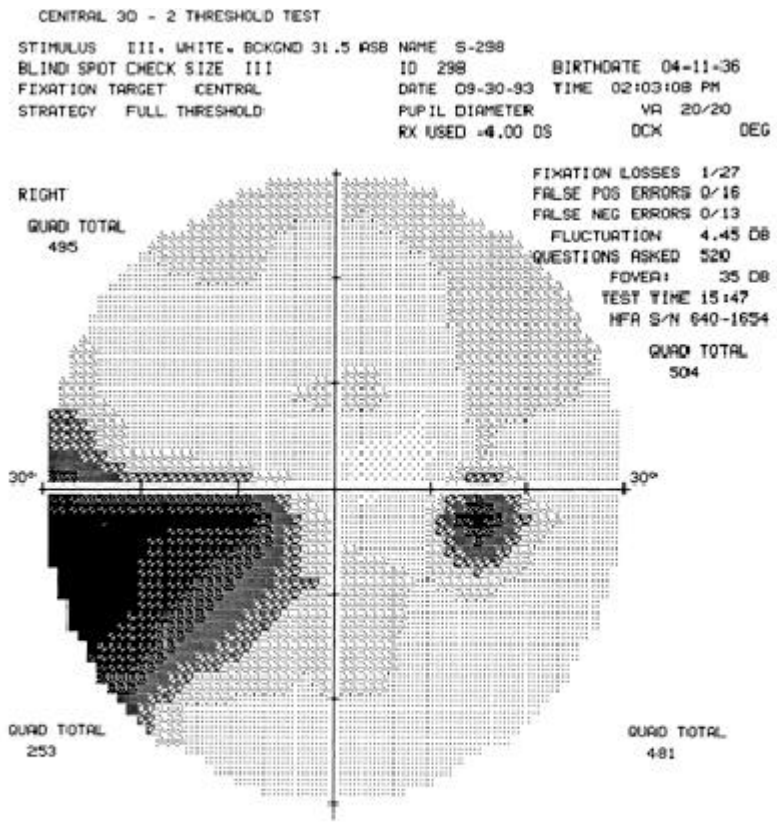
Gonio view of iris stump

Foveal Hypoplasia & Corneal Pannus



NORMAL TENSION GLAUCOMA





Q:

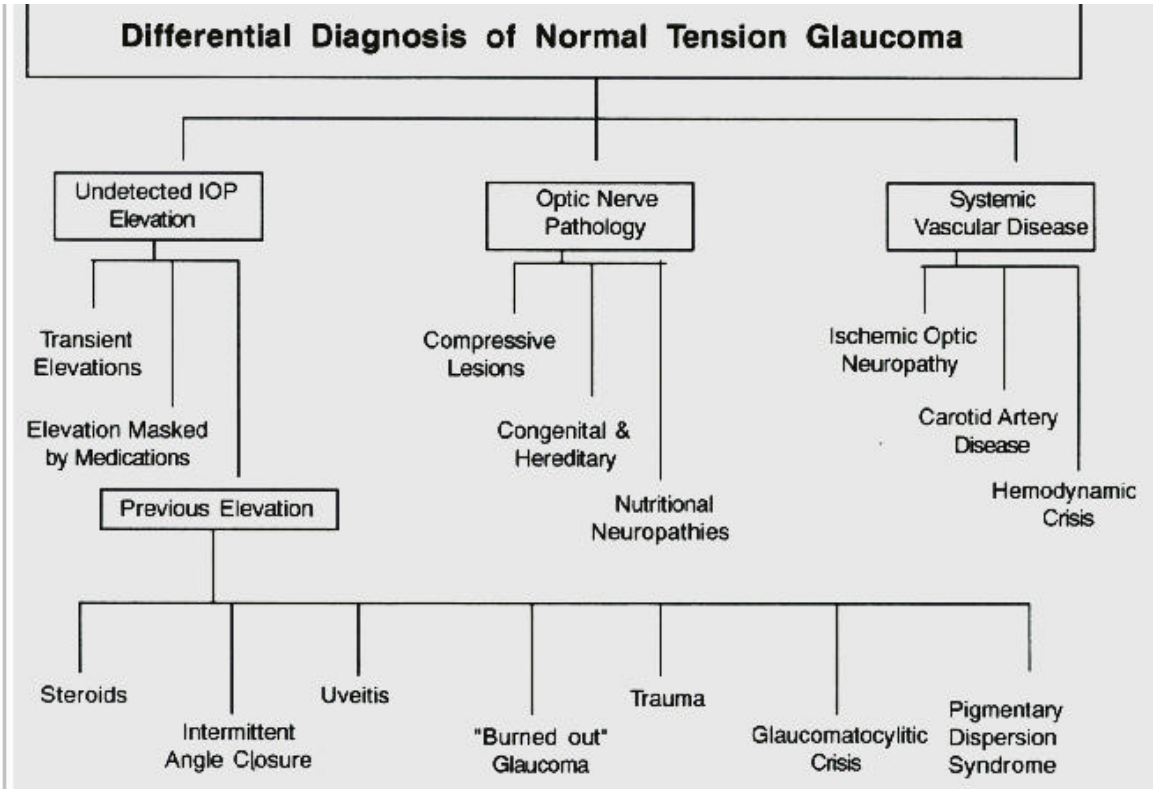
- This is a middle age female with IOP ranging between 10-20 what does she have?
- Show how the VF corresponds to the changes in the optic nerve
- Asks definitions of terms on VF printout
- Asks questions about gray scale reading
- How would you manage this patient?
- Would you use 5-FU in a NTG case?

A:

- Normal tension glaucoma
- The nerve fibre bundle defect/area of notching in the cup seen in the photograph corresponds to the area of VF loss noted

DIFFERENTIAL DIAGNOSIS

- The diagnosis of normal-tension glaucoma is a diagnosis of exclusion.



Undetected Intraocular Pressure Elevation

TRANSIENT ELEVATIONS OF INTRAOCULAR PRESSURE

- Ruling out undetected chronic open-angle high-tension glaucoma should be a primary initial objective.
- Diurnal variations in intraocular pressure ar
- Even a diurnal pressure curve determination in the office may not detect transient spikes in pressure that occur late in the day or night.
- Such spikes may occur at the same time every day or may occur in an irregular pattern. In addition to daily fluctuations some individuals show fluctuation of intraocular pressure over several days, weeks, or months— The so-called "phasic variation." Their intraocular pressures may be normal for weeks, but then for several days the pressure rises to abnormal levels at which time glaucomatous damage occurs.
- It is thought by some that spikes of high pressure often occur in patients with abnormally low outflow facility who, for unknown reasons, at times secrete a greater amount of aqueous. On such occasions a sporadic rise in intraocular pressure is thus produced.
- There is considerable evidence that altering body position affects intraocular pressure. It is possible that postural changes of intraocular pressure play a more significant role in normal-tension glaucoma than is presently realized.
- Eliminating transient elevations of intraocular pressure from the differential diagnosis of normal-tension glaucoma is not an easy task. Home tonometry has been advocated and is gaining in popularity.

PREVIOUS ELEVATION OF INTRAOCULAR PRESSURE

- Such an example is the individual who develops secondary glaucoma from the use of corticosteroids. Upon cessation of the steroid therapy the intraocular pressure returns to normal but the patient is left with permanent, albeit nonprogressive, disc cupping and visual field loss.
- Other conditions that could produce a temporary but damaging elevation of intraocular pressure include uveitis, trauma, glaucomatocyclitic crisis, pigmentary dispersion syndrome, and intermittent angle-closure. At the time of initial presentation these secondary glaucomas may be in remission, and it is only through a careful history and examination that their prior existence can be suspected.
- One entity that has been frequently mentioned in the literature is "burned-out glaucoma." Patients with this condition are described as having had chronic open-angle glaucoma in the past with high tension and the resultant sequelae. Late in the course of the disease the untreated intraocular pressure drops as the result of ciliary body atrophy and aqueous hyposecretion. When first seen, such patients have normal intraocular pressure, very low outflow facility, and are usually elderly with end-stage glaucomatous disease.

ELEVATION MASKED BY MEDICATION

- A single daily dose of digoxin in the digitalized patient is sufficient to maintain the secretory inhibition of aqueous and to significantly lower intraocular pressure
- acetazolamide suppressed aqueous formation by 50 percent
- Beta-blockers constitute another category of systemic drugs that can lower intraocular pressure. 10 to 40 mg of propranolol (Inderal) administered orally three times a day.

- In some cases short-term discontinuance of a systemic drug may be useful to detect the presence of a hidden high-tension glaucoma.

Optic Nerve Pathology

COMPRESSIVE LESIONS

- Because of their treatable nature, compressive lesions of the visual pathway should be foremost on the list of important entities to be considered.
- Optic atrophy caused by tumors of the optic nerve or chiasm have been mistaken for glaucomatous cupping.

CONGENITAL AND HEREDODEGENERATIVE ABNORMALITIES

- congenitally large physiologic cups, hypoplastic discs, myopic discs, oblique insertion of the optic nerve, colobomas, pits, and drusen of the nerve head.
- Since many of these conditions may also be associated with visual field defects, the clinician must be vigilant to properly identify these entities.
- Hereditary disorders such as Leber's disease and Behr's syndrome should be included in the list of conditions that cause optic neuropathy. The optic atrophy associated with these conditions usually poses no diagnostic problem since cupping is not part of the clinical picture. Mention should be made, however, of a dominant form of juvenile optic atrophy that is characterized by temporal disc pallor and temporal sectoral excavation.

NUTRITIONAL NEUROPATHIES

- Nutritional amblyopia, pernicious anemia, and vitamin B deficiency are often included in the differential diagnosis of normal-tension glaucoma.
- In most cases the optic neuropathy produced by these entities should not pose a diagnostic problem, since the field defects are usually central or cecocentral and the discs are not cupped.

Systemic Vascular Disease

ISCHEMIC OPTIC NEUROPATHY AND CRANIAL ARTERITIS

- Altitudinal and arcuate scotomata have frequently been associated with ischemic optic neuropathy, cranial arteritis, and emboli.
- In all of these conditions infarction of the optic nerve is believed to play a dominant role. Disc edema may be present initially, but as the swelling resolves optic atrophy ensues and temporal disc pallor appears. In some cases cupping develops and resembles that seen in normal-tension glaucoma.
- In the early literature some authors classified normal-tension glaucoma as a chronic form of ischemic optic neuropathy. Indeed, in an atypical case without a history of sudden visual loss and in the presence of a glaucomatous appearing disc, it may be very difficult to exclude ischemic optic neuropathy from the differential diagnosis.

HEMODYNAMIC CRISES

- Acute hypotensive episodes due to events such as myocardial infarction, cardiac arrest, massive hemorrhage, or shock have been thought by some investigators to play a role in the production of cupping and visual field loss.
- Decreased perfusion may lead to optic nerve damage in patients who experience a hemodynamic crisis.

- important for the clinician to inquire about the possibility of past hemodynamic crises when the differential diagnosis of normal-tension glaucoma is being considered.

CAROTID ARTERY DISEASE

- Because isolated case reports of cupping and carotid disease have been reported, it should be listed in the differential diagnosis. In elderly patients sclerotic vessels can cause temporal compression effects on the optic nerve in the sella. In such cases progressive visual field loss and optic atrophy may ensue.
- Some cases of arteriosclerotic chiasmal syndrome cause nasal depressions in the field that could be mistaken for glaucomatous damage.