GLAUCOMA AND BOUVIERS
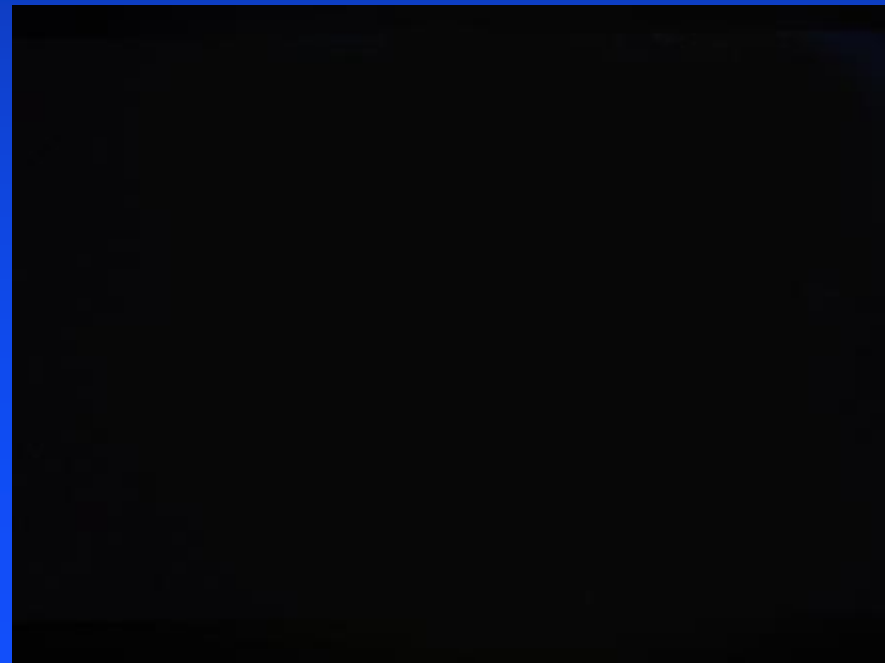

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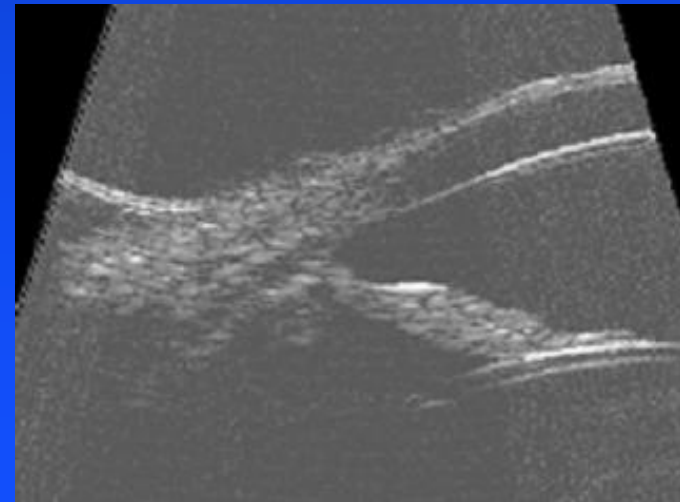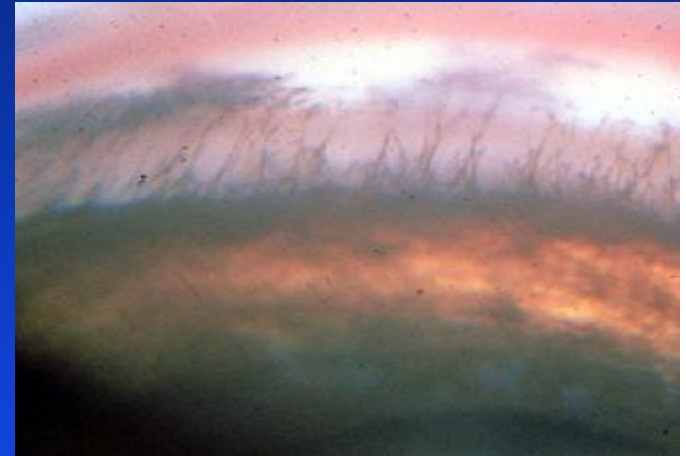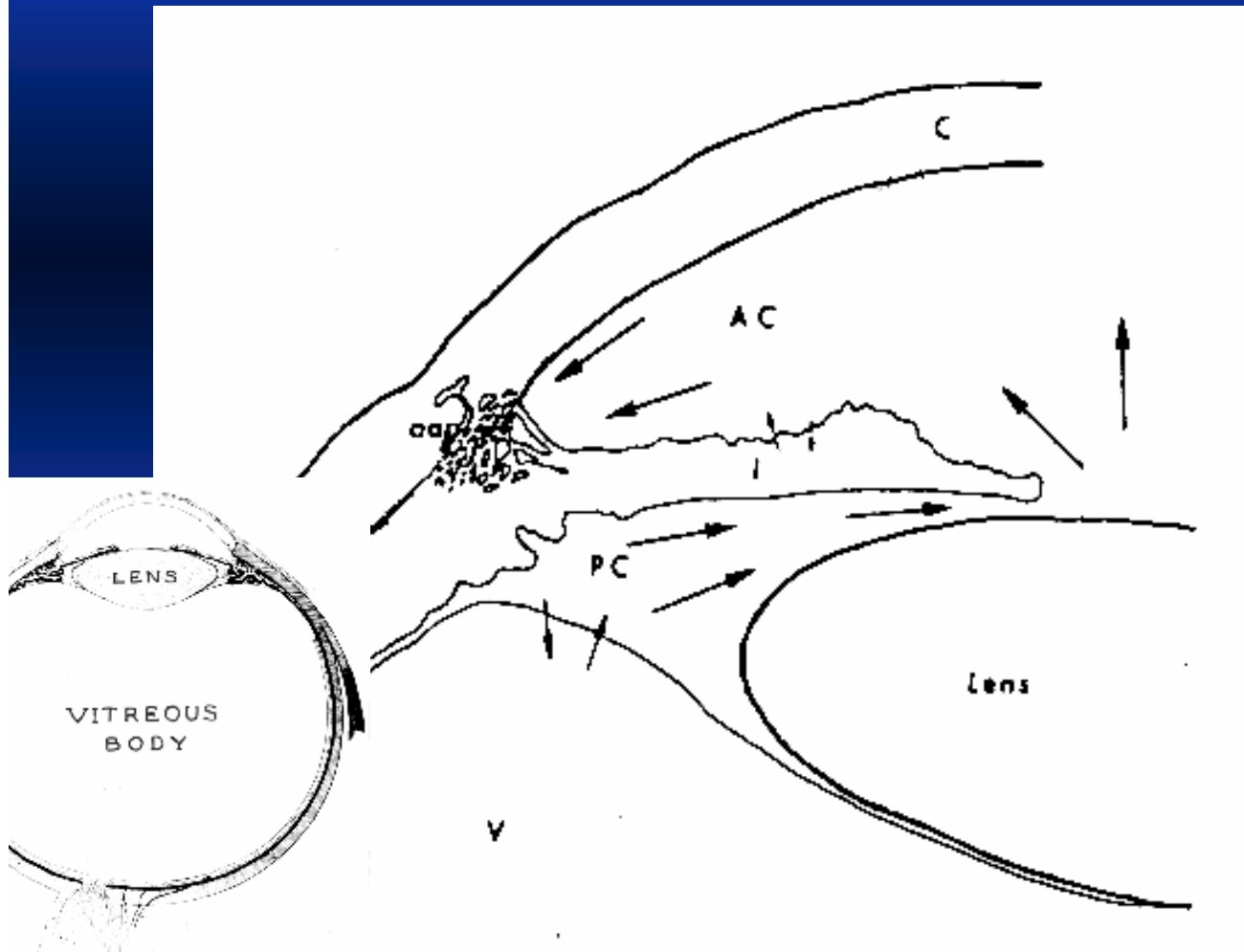
GLAUCOMA: A *diverse group* of diseases united only by the fact that IOP is too high for the optic nerve to work properly and some or all of the dog's vision is lost

Intraocular Pressure

What flows in = What flows out

Causes

Outflow is #1 Problem

"Primary" No obvious association with another ocular or systemic disorder – both eyes, genetic

Open angle – open/closed cleft

Closed angle – open/closed cleft

"Secondary" Another ocular or systemic disorder is present one or both eyes, +/- genetic

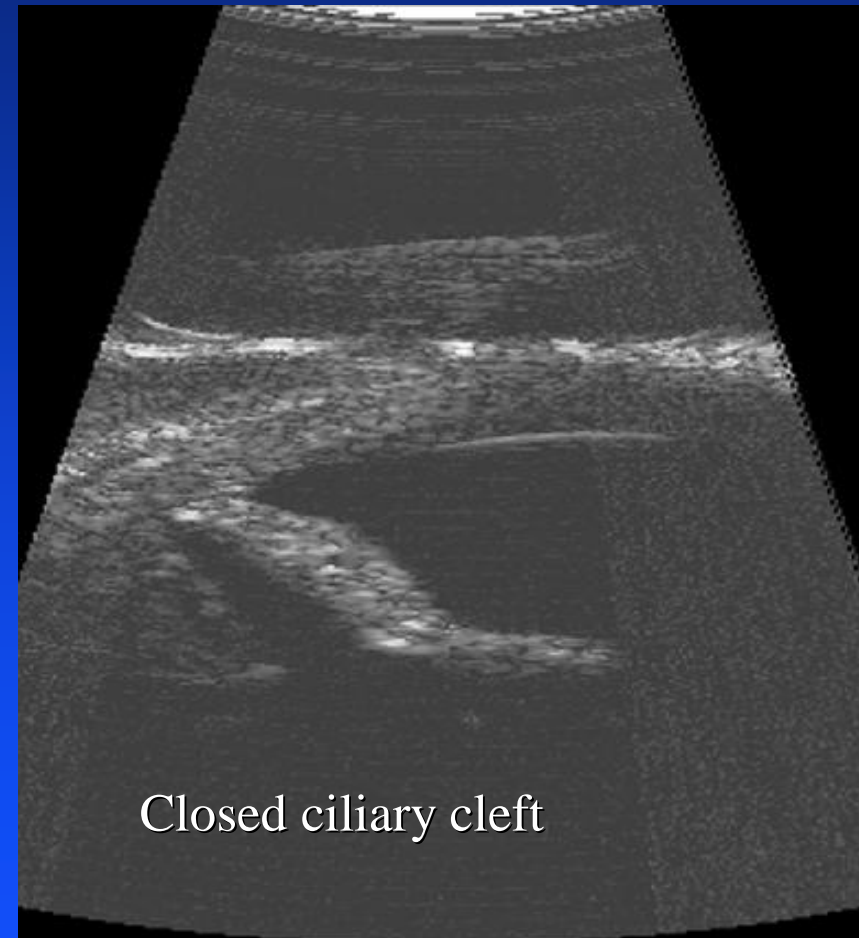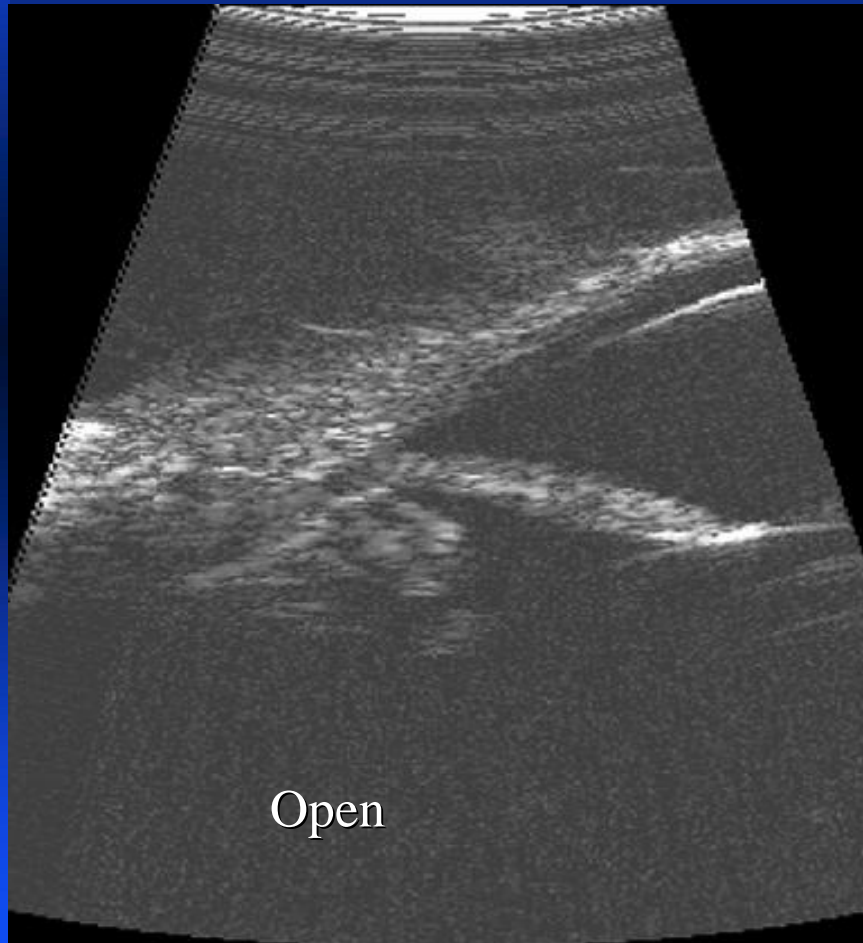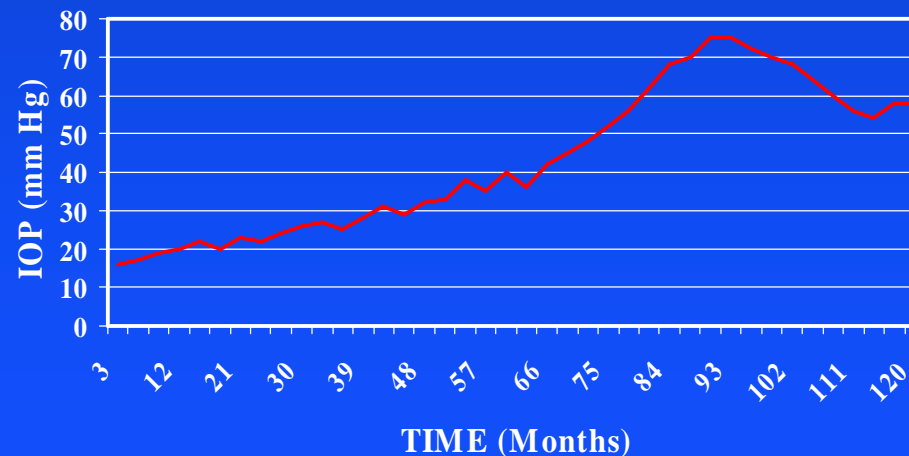| Lens associated | Inflammatory |
| Blood | Tumors |
| Others | |

How do we look at the outflow path?

"Open" angle

"Closed" angle

eyevetclinic.co.uk

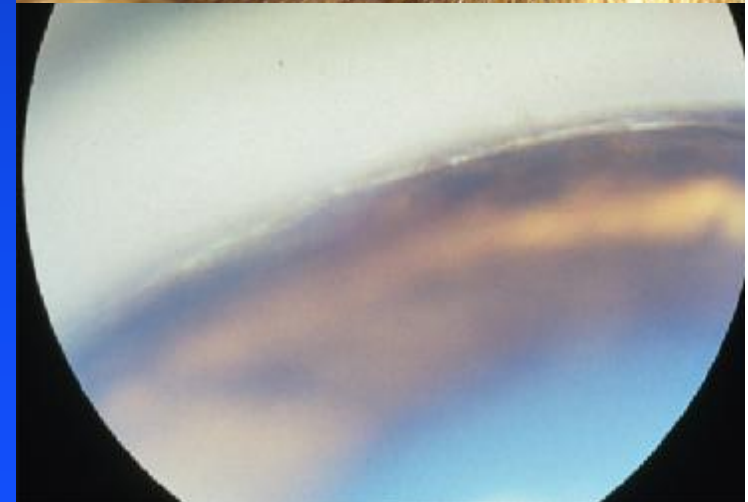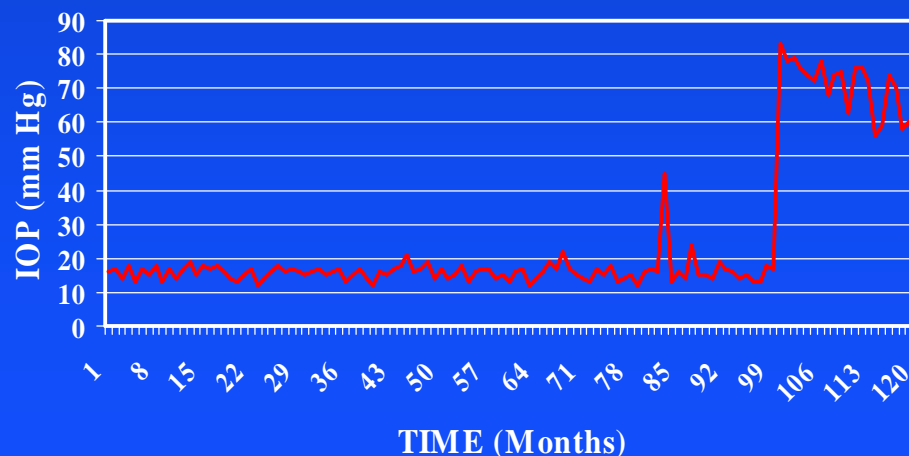# New ways of looking at the outflow: The cleft

Open

Closed ciliary cleft

Glaucoma overview: Primary Open Angle Glaucoma
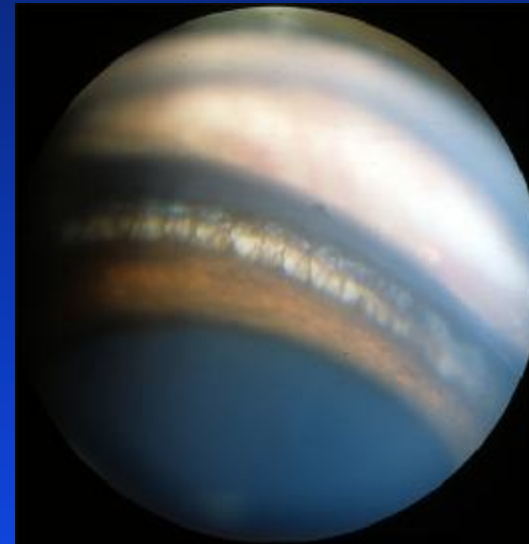
Glaucoma overview: Primary Angle Closure Glaucoma

- Marked IOP↑

- Pain

- Red eye/Hazy cornea

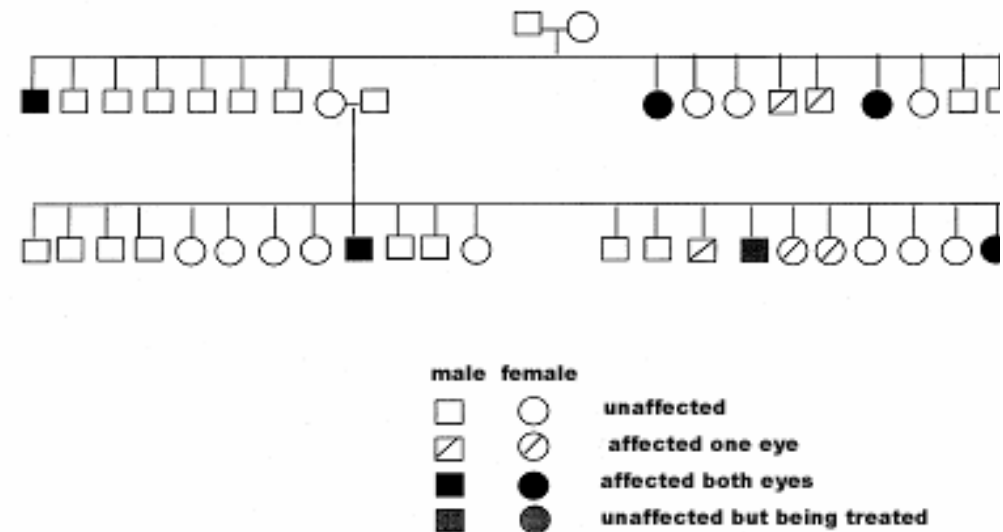- Fixed semi-dilated pupil

- Rapid vision loss

PACG Risk Factors

- Mid/older age
- Dim light/night
- Mid-range pupil

- Females 2:1
- Stress
- Genetic

Genetics:
The Angle

male	female	
□	○	unaffected
▨	⊘	affected one eye
■	●	affected both eyes
▦	◉	unaffected but being treated

- PACG is polygenic in humans and undoubtedly dogs
- Heritability of angle is 56% (Samoyed)
- So ½ of PACG is *NOT* simply angle genetics but other factors
  – Shape of the front portion of the eye, sex, age, stress etc
- Almost every dog with PACG has bad angles but only 1.5% with bad angles gets PACG
- "Bad" angles are just the first "hit"

Genetics of the Angle

Ruthless selection vs PLD can ↓ frequency of PLD in a line

But: - PLD came from selecting *for* something else in many breeds

- What new problems will be unintentionally selected for?

- What cost to the breed?

STUDY: Can we better ID dogs at risk of PACG by looking for other potentially genetic factors?
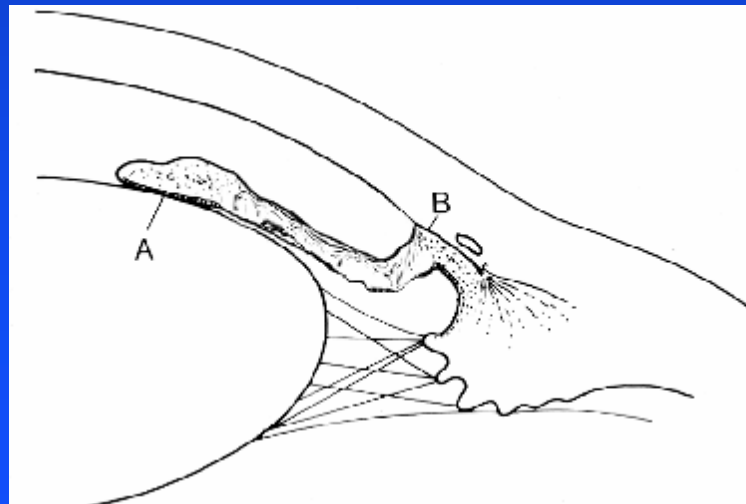
Other Potential Genetic "Hits"

Humans

- Shallow AC
- Thick/forward lens
- Far-sighted
- Mid-range pupil
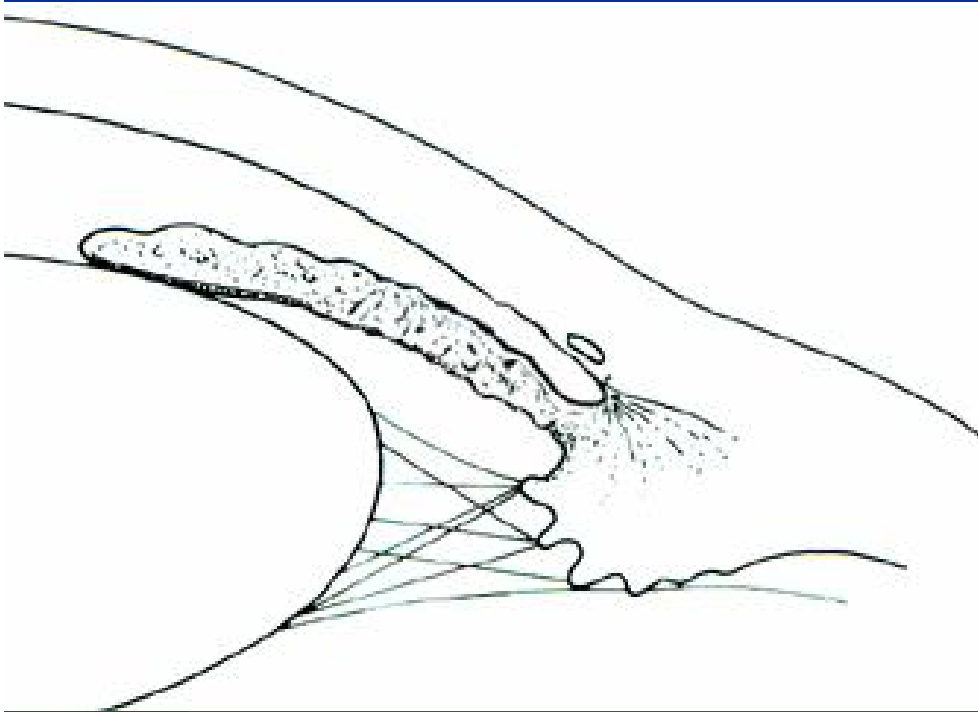- Abnormal iris position

Dogs

- Shallow AC
- Thick/forward lens
- Far-sighted?
- Mid-range pupil
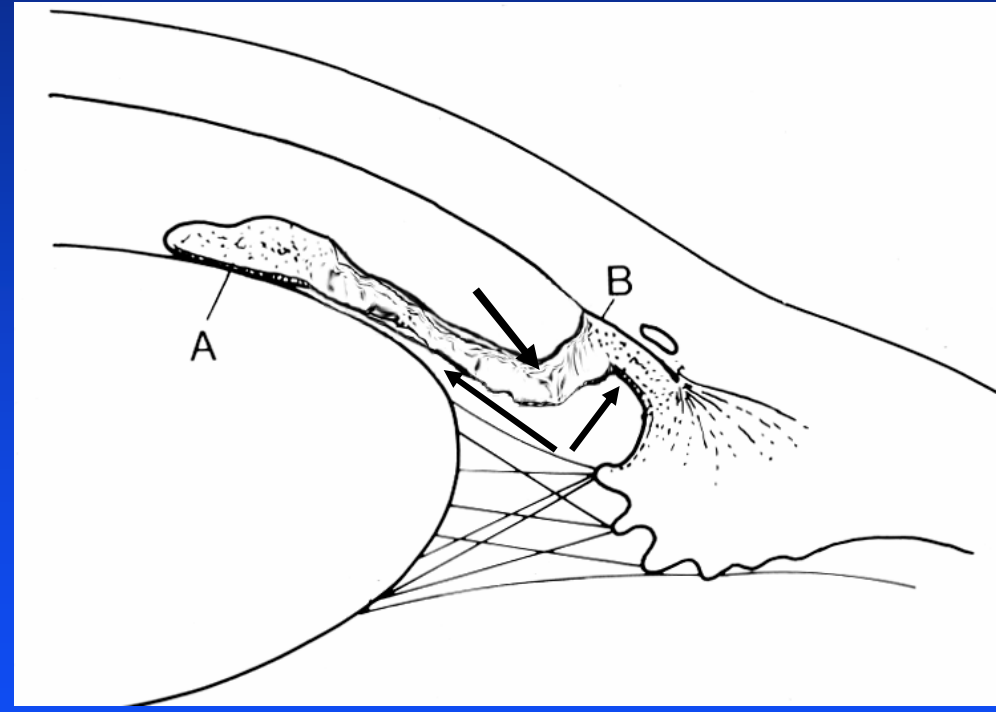- Abnormal iris position

Other Non-genetic Factors

- PACG is probably not all genetic
- Short-term increases in blood pressure?
- Things that put the pupil in the middle
- Things that "crowd" the front of the eye
  - Lens growth, drugs etc
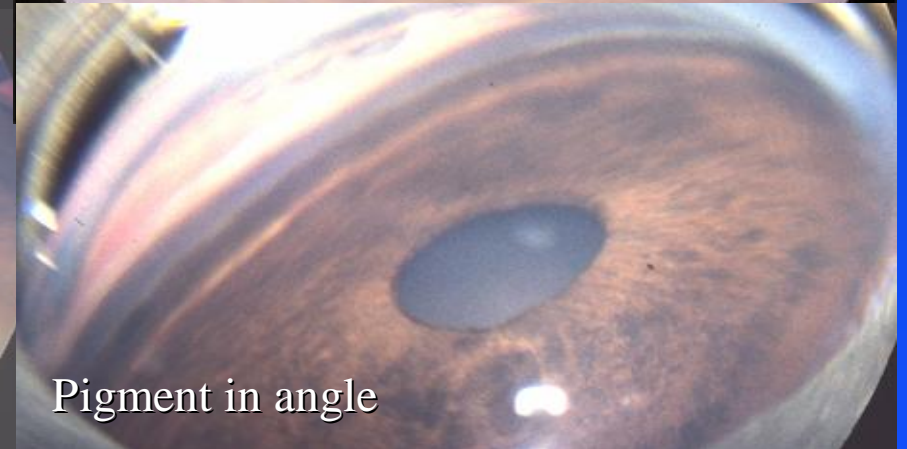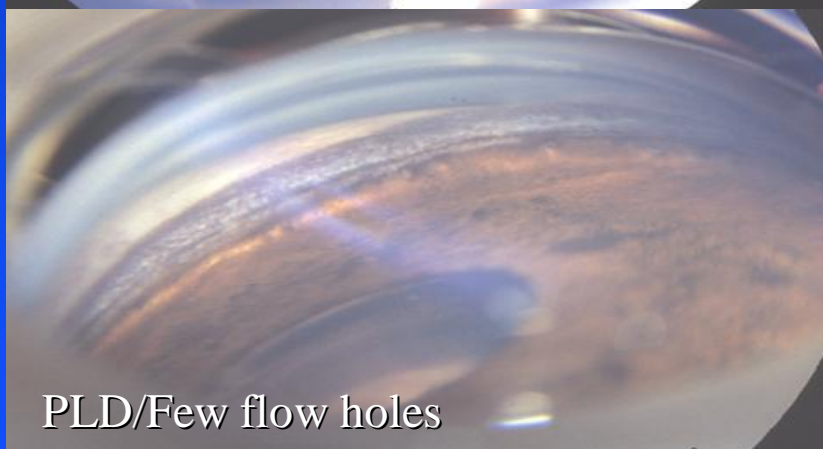
How PACG Develops

Normal

PACG
PLD is only first "hit"

Selecting by Angles:
Currently the only game in town

BBPL

PLD/Sheets

PLD/Few flow holes

Pigment in angle

Angle Scoring

Terminology	Closed	Narrow	Slightly narrow	Open	Wide open
Numerical grade	0	I	II	III	IV
Relative interval (x = A/B)	x≤0.15	0.15<x≤0.30	0.30<x≤0.45	0.45<x≤0.55	0.55<x

Ekesten AJVR 1991
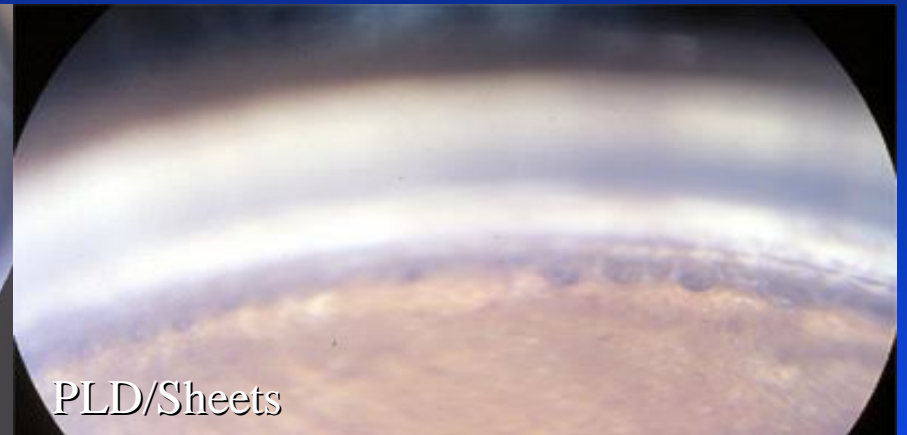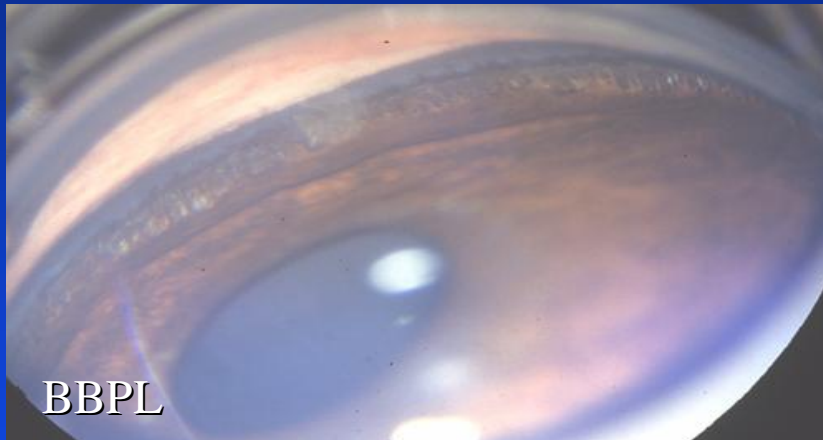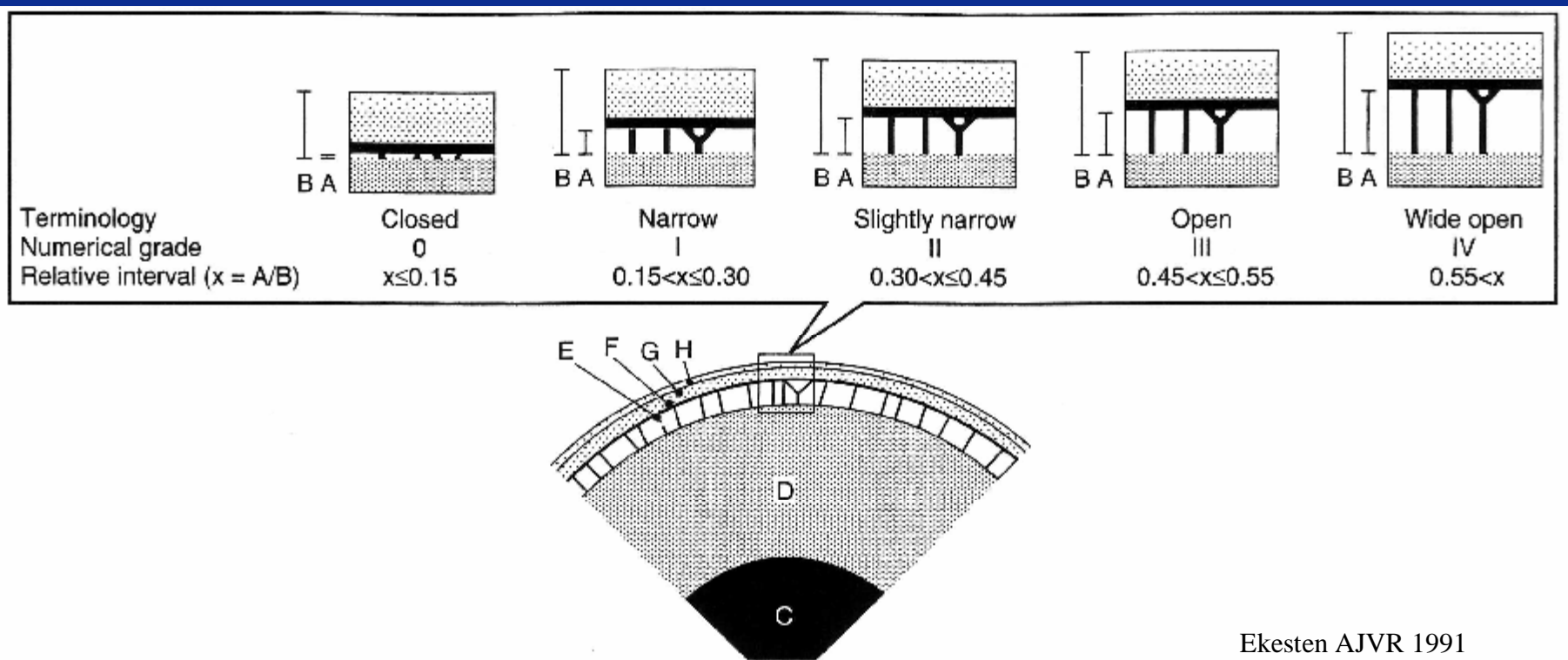
Grade by Width and by extent of Pectinate Ligament Dysplasia

Other scoring schemes

- % of normal
- Mild, moderate, severe
- "Good" or "Bad"

PACG – Its not only sudden onset

- Latent - "at risk" fellow eye
- Intermittent – attacks that spontaneously resolve
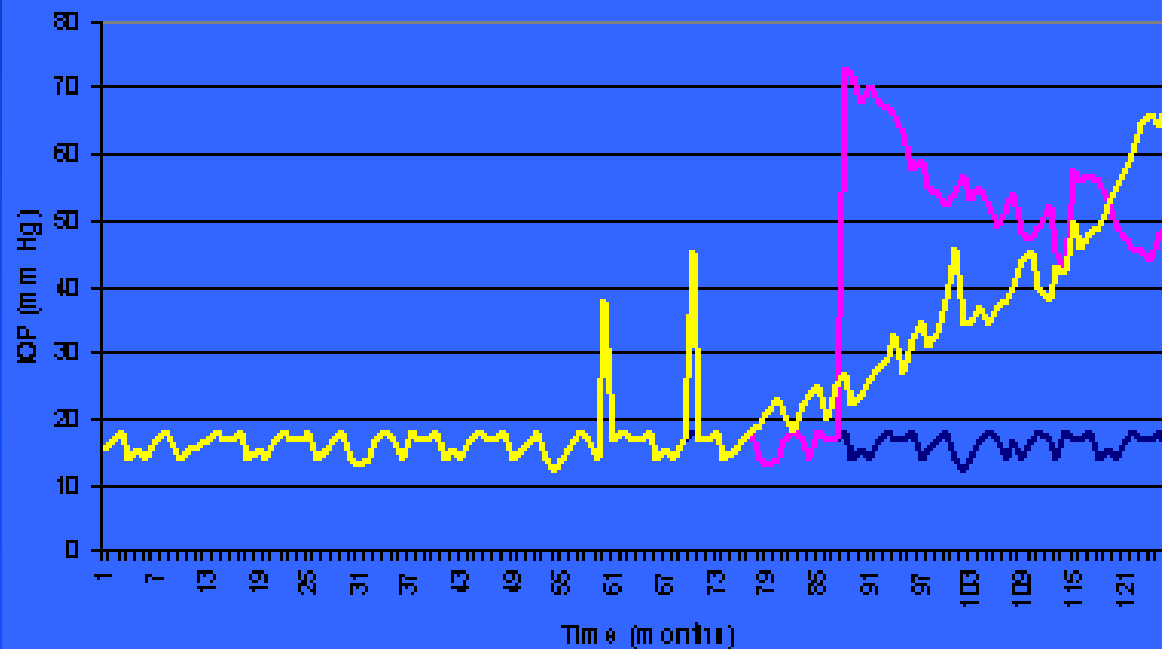- Acute congestive – sudden attacks that don't resolve
- Post congestive – had an attack but now normal IOP
- Chronic – gradual increase
- Absolute – end stage

Latent Form

- "Normal" fellow eye
- At high risk – 50% in 8 months
- Abnormal angle/S-shaped iris
- Cleft open initially – may close later
- Preventative drops lower risk to 50% in 30+ months

Possible Course
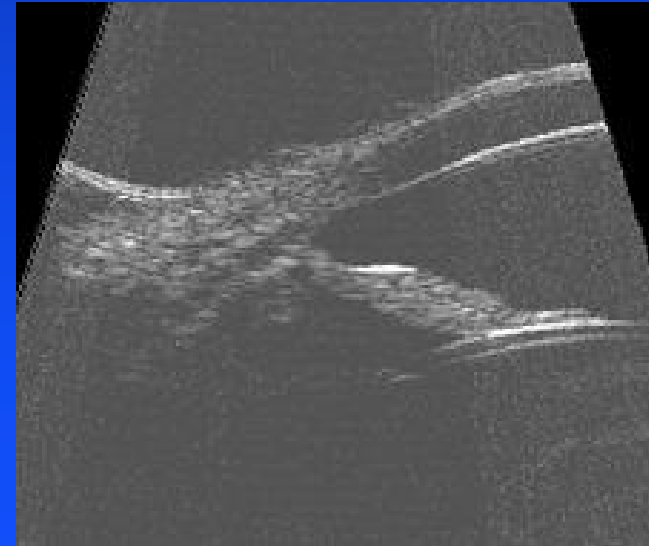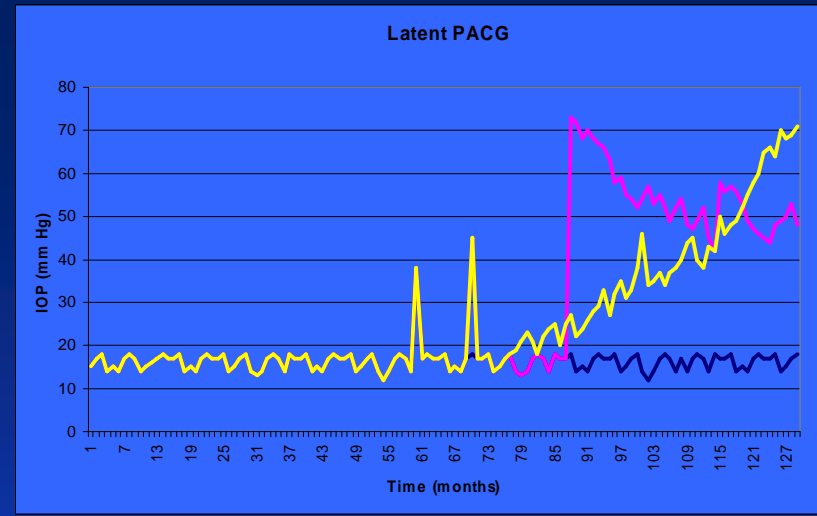
Intermittent Form

- 8-yr-old FS Cocker Spaniel
- Vague Hx transient red eye at night or with child crying
- Has PLD both eyes

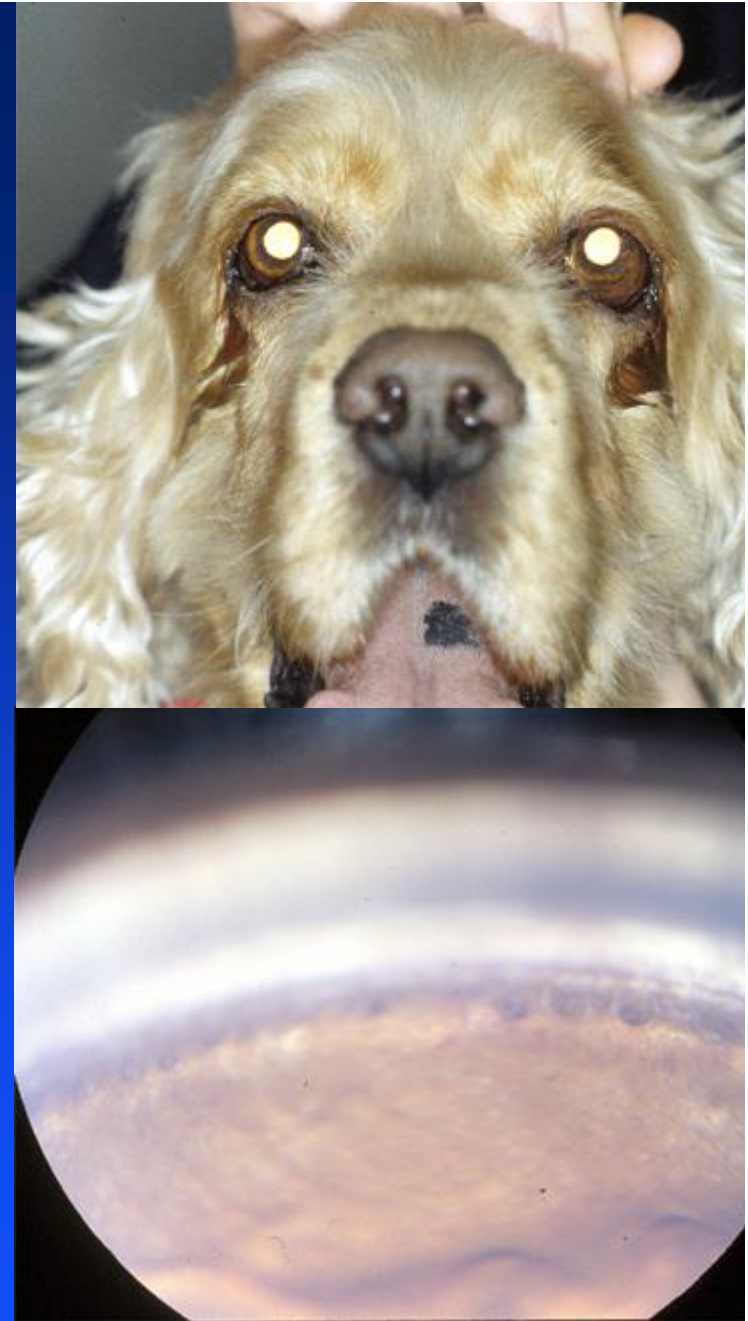|	R	L
8AM	15	17
9AM	13	21
11AM	16	23
1PM	17	41
2PM (latano)	16	12

- Cleft Closed on HRUS

Intermittent PACG - Course

Intermittent PACG

IOP (mm Hg) vs Time (months)

Legend:
- Remain normal
- Develop acute PACG
- Develop chronic PACG
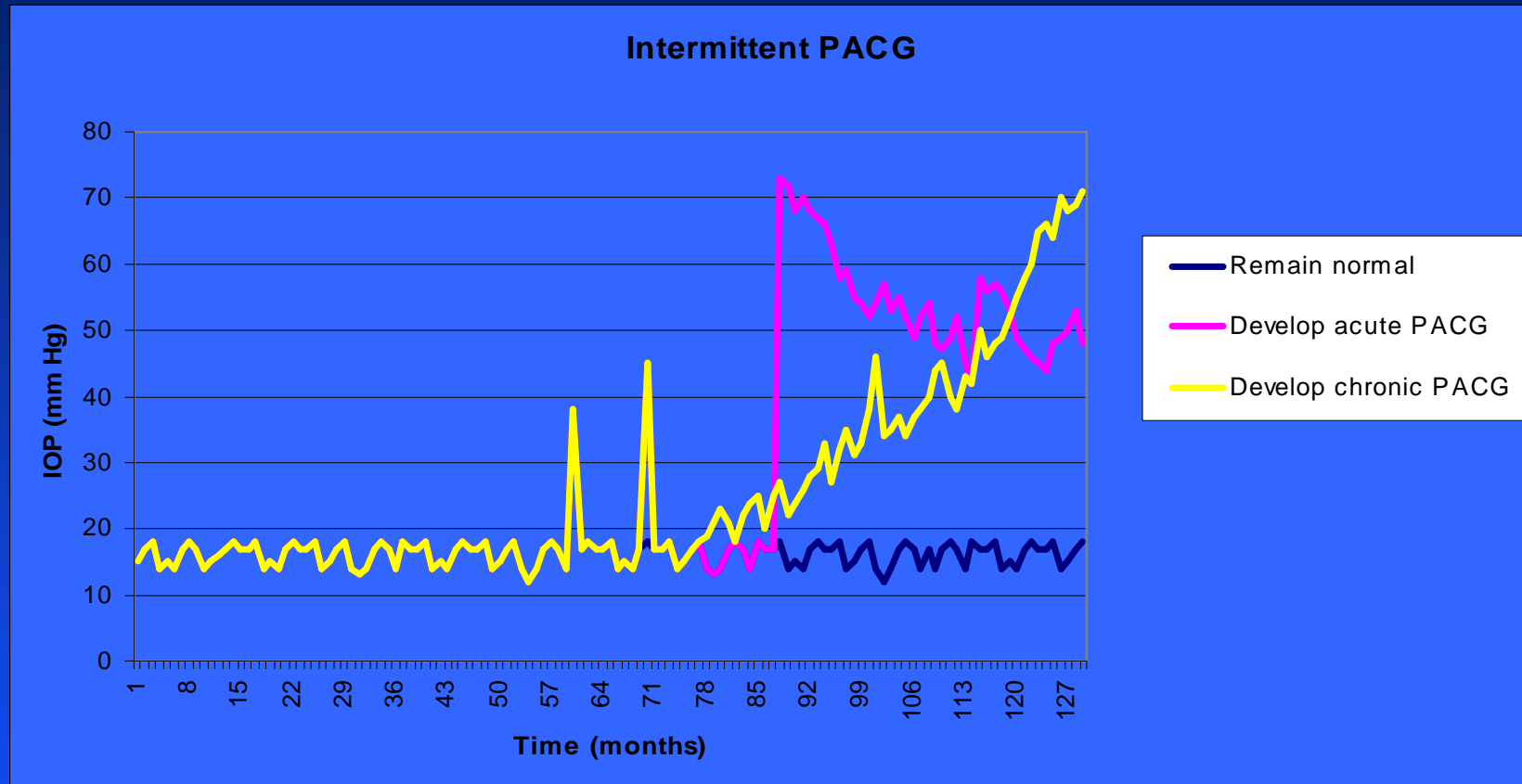
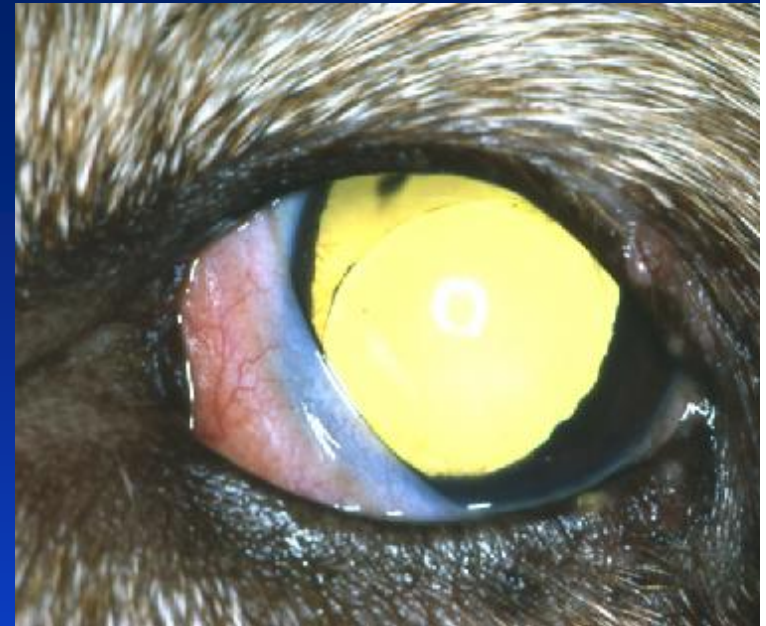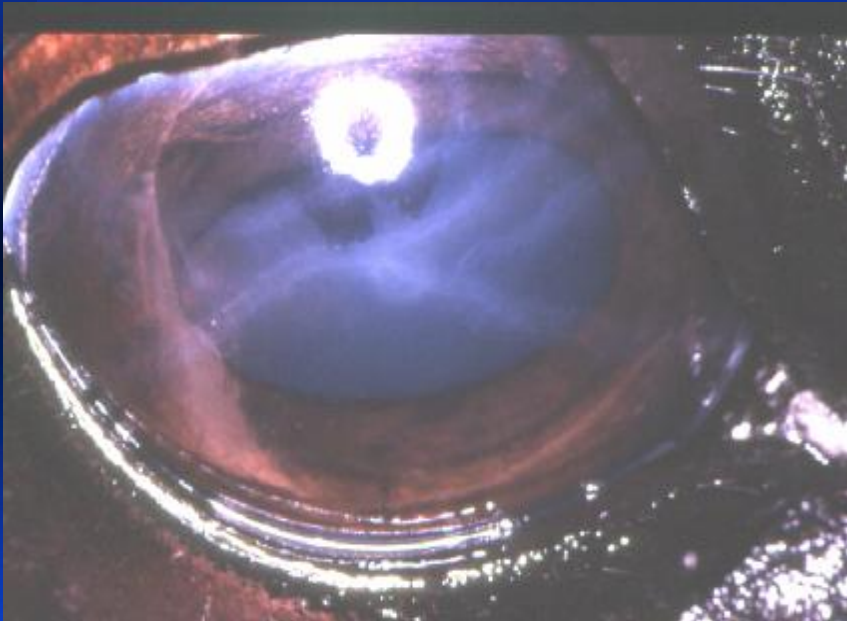- Remain normal – rare
- Develop acute PACG – most common
- Develop chronic PACG - occurs

Absolute Glaucoma

BHF Study: Better Prediction

- PLD is common in Bouviers
- Only 1-2% with PLD develop PACG
- Therefore other factors may trigger an attack
- What are these factors?
- Can we use them to better identify "at-risk" dogs so we can target preventative therapy better and improve breeding advice?

Better Prediction

- Prospective
    - 98 "normal" eyes, 50 Bouviers
    - 2 one-eyed from PACG
    - Mean age: 63.3 mo range 10-140 months
    - 17 males, 33 females
- Slit-lamp/Indirect
- IOP pre/post-pupil dilation
- Gonioscopy
- Streak retinoscopy
- A-, B-, and 20 MHz high resolution ultrasonography (HRUS)
- Especially ± 2 sd from mean

Courtesy of I[3]

Ekesten AJVR 1991
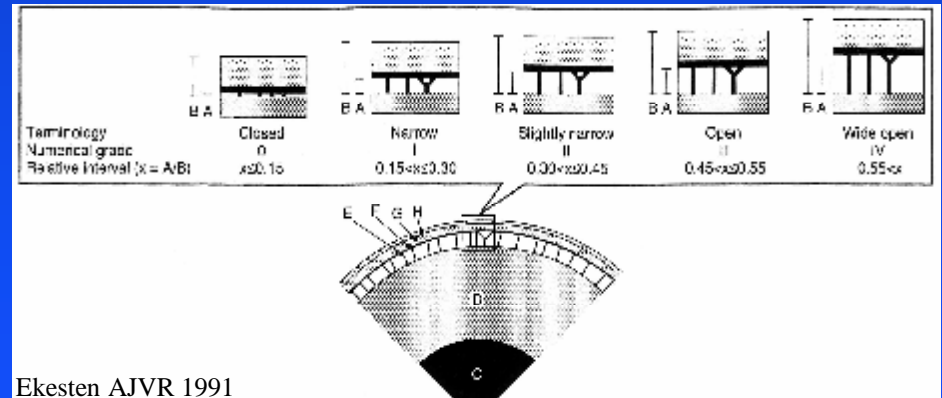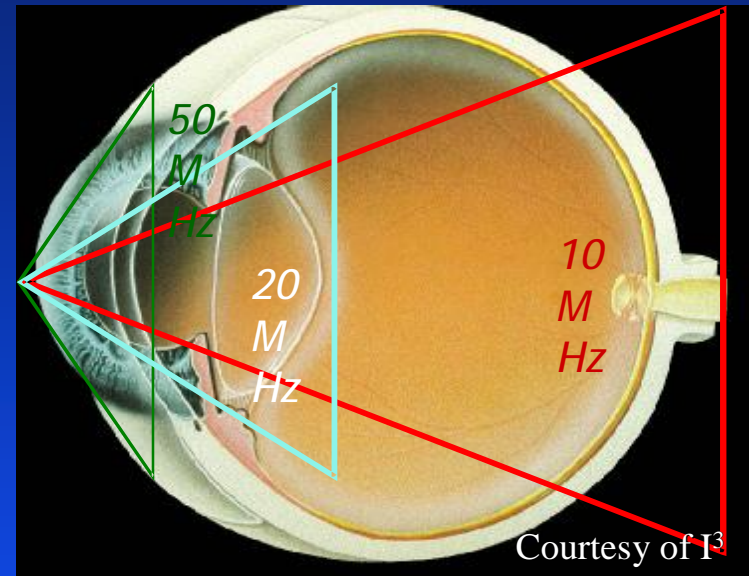
Prediction - Gonioscopy

- 76% had some PLD (75% in Europe)
- Only 10% were "open" or "wide open" 360°
- Only severe PLD associated with PACG
- But few (15%) with severe PLD had PACG
- Two forms of glaucoma occur in Bouviers
    - "Typical PACG" with PLD
    - Pigment in TM/Cleft – PLD not required
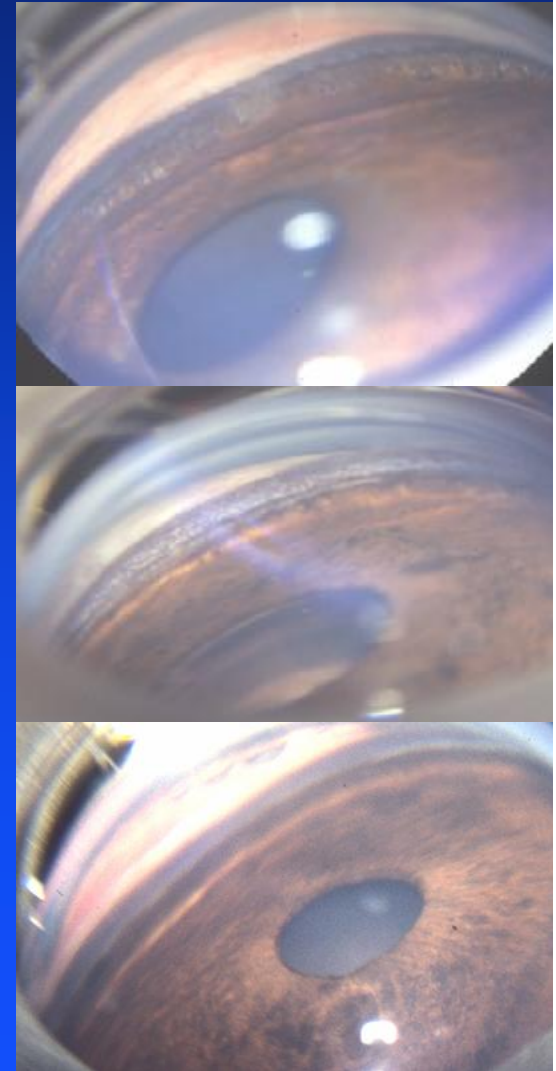
Prediction - Tonometry

- IOP Pre/Post dilation did not identify at-risk dogs
- IOP only useful in dogs who had an attack in one eye, had a red eye, or were being treated
- Increased IOP may be one of the last events
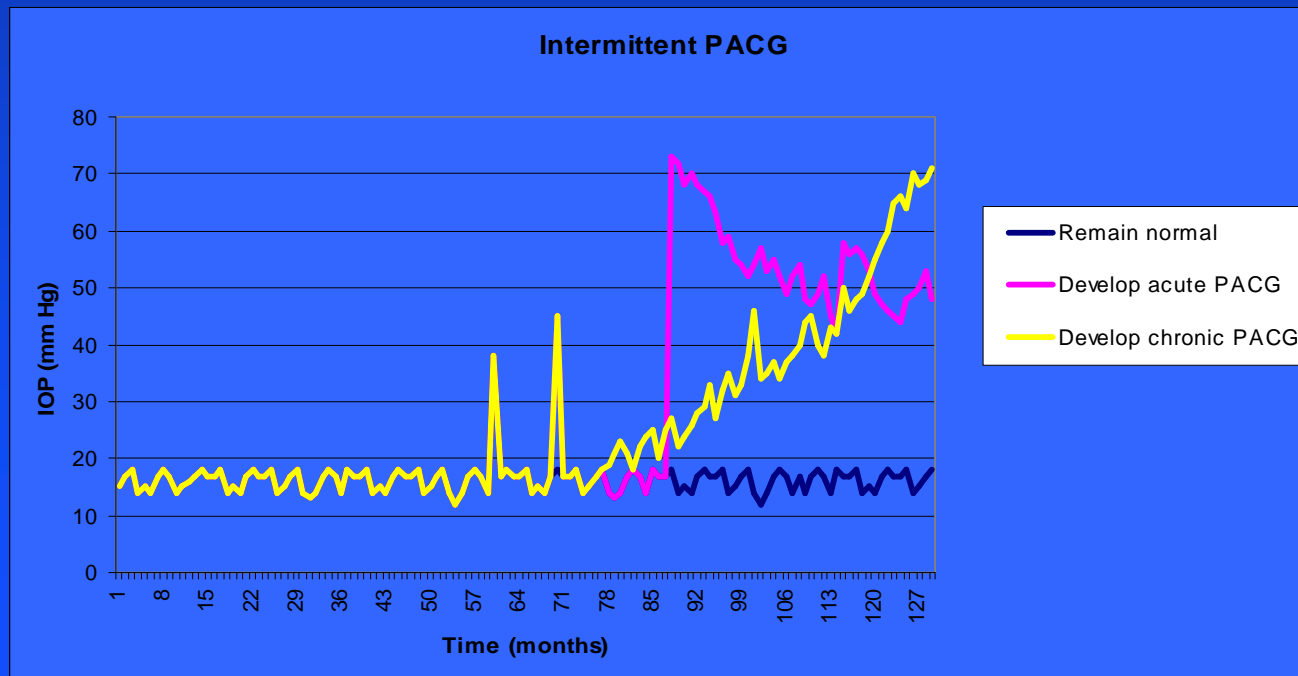
Intermittent PACG

Prediction - Retinoscopy

- Younger dogs more far sighted
- 50% ≥ 0.5D far-sighted
- Every dog > 2 sd had severe PLD, often closed cleft
- A shift to near-sightedness suggests intermittent spikes

Mean: + 0.38 D ± 0.85

Range: –3.0 to +2.5D

Refractive Status

Myopia

Hyperopia

Frequency

Diopters
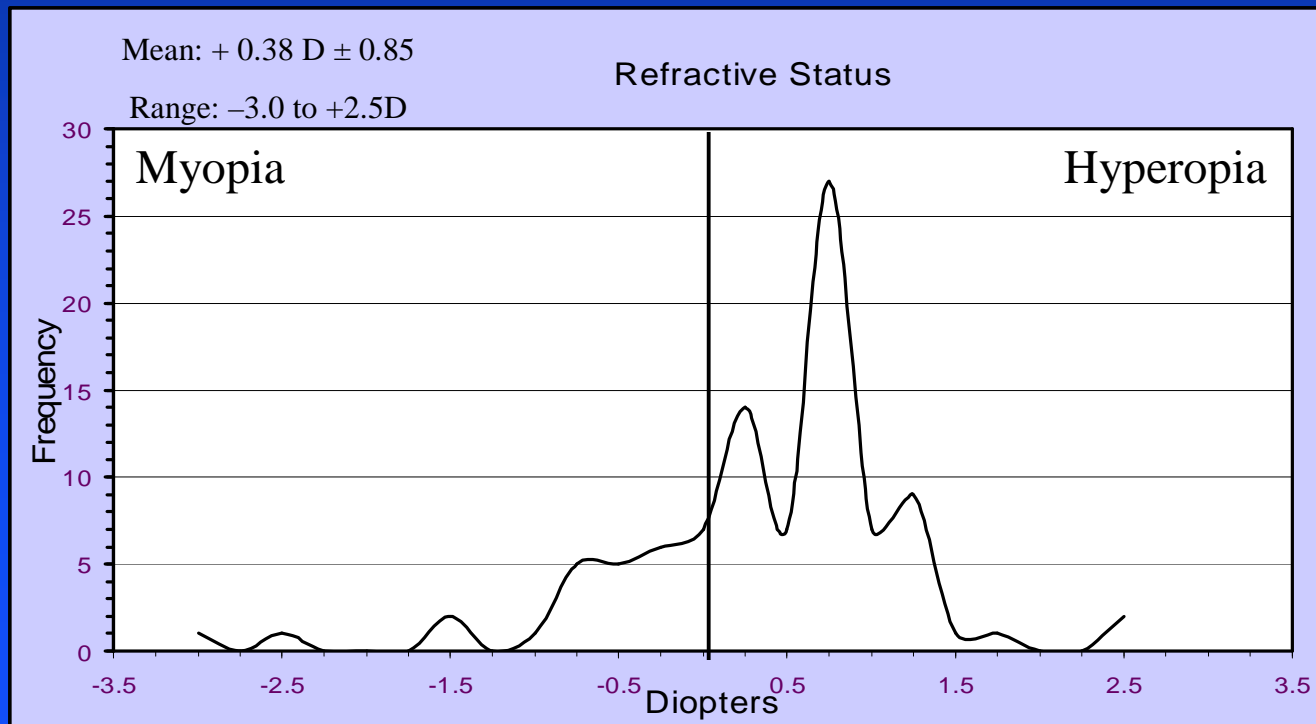
Prediction – A-Scan

- Shallow AC associated with PACG and TM pigment
- Lens gets bigger with age
- Need more dogs to see if explains female predisp

OS 12:55 JUN 17-04 AUTO 75dB
PHAKIC-1 1532/1641/1532
AXL = 20.98mm   LENS = 6.97mm   ACD = 4.30mm

Prediction - HRUS

35-mo-old male
severe PLD 2.5D hyperopia OU
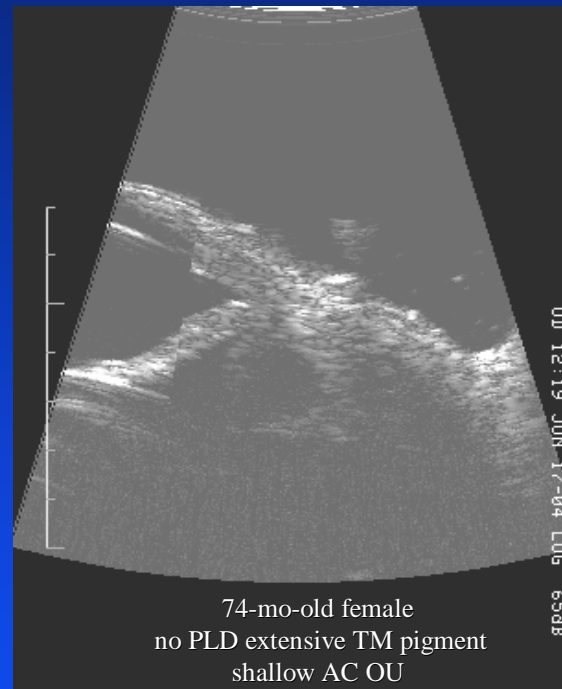
74-mo-old female
no PLD extensive TM pigment
shallow AC OU

50-mo-old male
severe PLD, narrow angle
overt PACG in the fellow eye
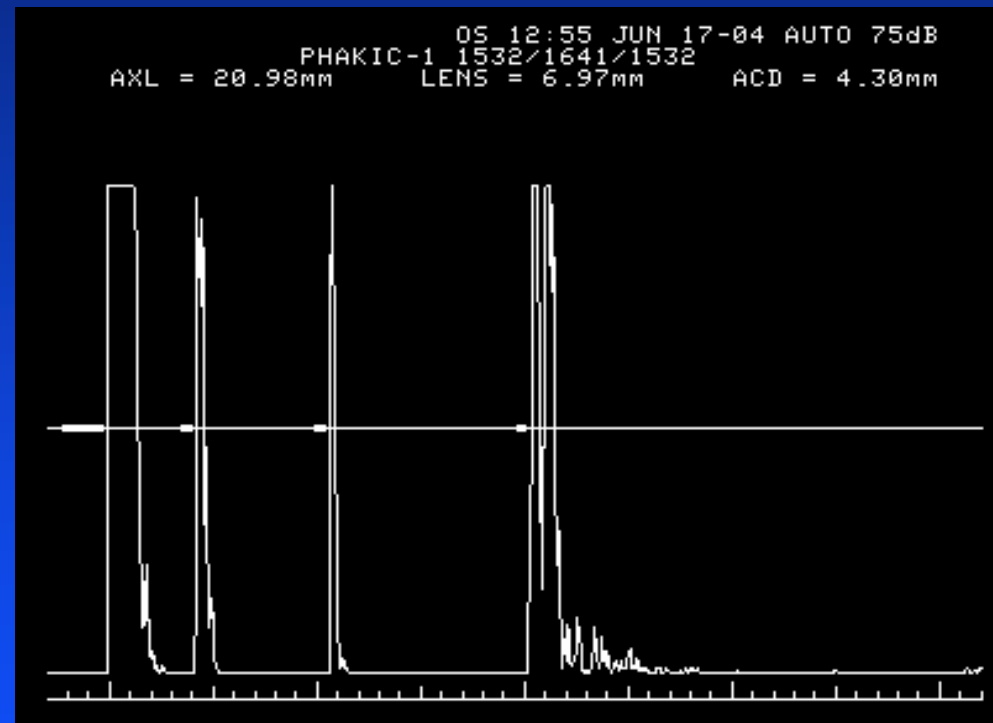
- Closed cleft associated with PACG and TM pigment
- Does closed cleft signal intermittent or impending glaucoma?

BHF Study Summary

Refractive errors, shallow anterior chamber, long axial length, and cleft closure also occur in addition to PLD in Bouviers and these factors may also contribute to PACG

Summary

1) Stress can trigger glaucoma in dogs

2) You might need to start to care about the ciliary cleft

3) Dog glaucoma is sort of like glaucoma in people

4) Bitches more likely to have glaucoma than dogs

5) Angles are not just something from geometry class

Some Remaining Questions

- Tonometric screening in dogs? NO
- Is ultrasound plus gonioscopy better than gonioscopy alone?
- Can refractive errors aid in prediction?
- Provocative tests?
- Genetic testing?
- New treatment options

Questions?