Should we be taking more than 2 images per eye?

SOUTH EAST LONDON DESP

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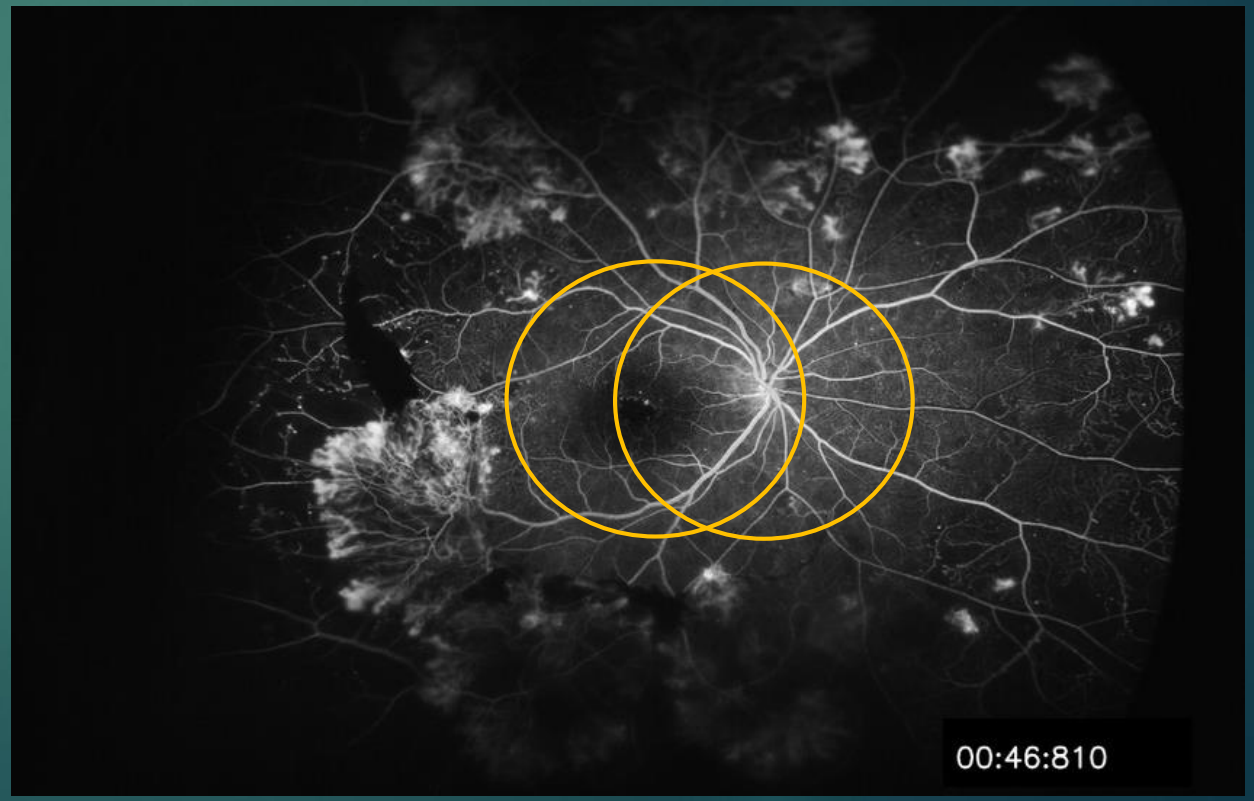
How many photographs should we take per eye?

- CURRENTLY according to National Protocol……
- Every patient in screening has 2 images taken per eye (Gold standard)
- **National Screening Protocol** has agreed this as acceptable and safe way of detecting majority of Retinopathy
- P Scanlon reported that two-field mydriatic digital photography gave a sensitivity of 80.2% and specificity of 96.2% in comparison with seven-field stereo-photography.
- 20% (1 in 5) will be missed
- 4% (1 in 25) will be referred unecessarily

7 field photography

- Gold standard in trials
- Not practical in clinics
- But..We know some PDR occurs outside the standard fields



BACK GROUND
Rationale for extra images?

- After 20 years of diabetes,
  - almost all patients with T1DM
  - 58% of patients with T2DM show signs of retinopathy. (1)
- Those with high risk proliferative retinopathy (R3), especially young patients with R3 can be blind after 5–10 years without treatment (2).
- The prevalence of R3 varies between 13 and 50% after 15–25 years of diabetes in patients who need insulin (3,4).
- Hence within our Programme we have adopted an approach where those with Diabetes >15 years have extra images taken

1. Klein R: The epidemiology of diabetic retinopathy: findings from the Wisconsin Epidemiologic Study of Diabetic Retinopathy. Int Ophthalmol Clin 1987;27:230–238
2. Deckert T, Simonsen SE, Poulsen JE: Prognosis of proliferative retinopathy in juvenile diabetics. Diabetes 1967;16:728–733
3. Klein R, Knudtson MD, Lee KE, Gangnon R, Klein BE: The Wisconsin Epidemiologic Study of Diabetic Retinopathy: XXII. The twenty-five-year progression of retinopathy in persons with type 1 diabetes. Ophthalmology 2008;115:1859–1868
4. Rossing K, Jacobsen P, Rossing P, Lauritzen E, Lund-Andersen H, Parving HH: Improved visual function in IDDM patients with unchanged cumulative incidence of sight-threatening diabetic retinopathy. Diabetes Care 1998;21:2007–2015

Pros and Cons of taking extra images

Advantages

- Less risk of missing R3 disease (increased risk of R3 with duration of diabetes)
- Grader more assured where suspicious areas on edge of photo
- May prevent sight loss in patient with R3 by allowing urgent referral (risk of bleeding)

Disadvantages

- Extra time to take images
- Extra time to grade images
- Longer to sync/ risk of crashing system
- Less time spent analysing each image
- Risk of skipping grading
- Risk of forgetting extra images (recent case in clinic)
- Less able to use automated grading

Audit Set Up looking at Effectiveness of Extra Images taken at screening

- **Aim**
- To identify whether taking extra images is worthwhile and detects extra R3 disease to allow appropriate referral

Audit Set Up looking at Effectiveness of Extra Images taken at screening

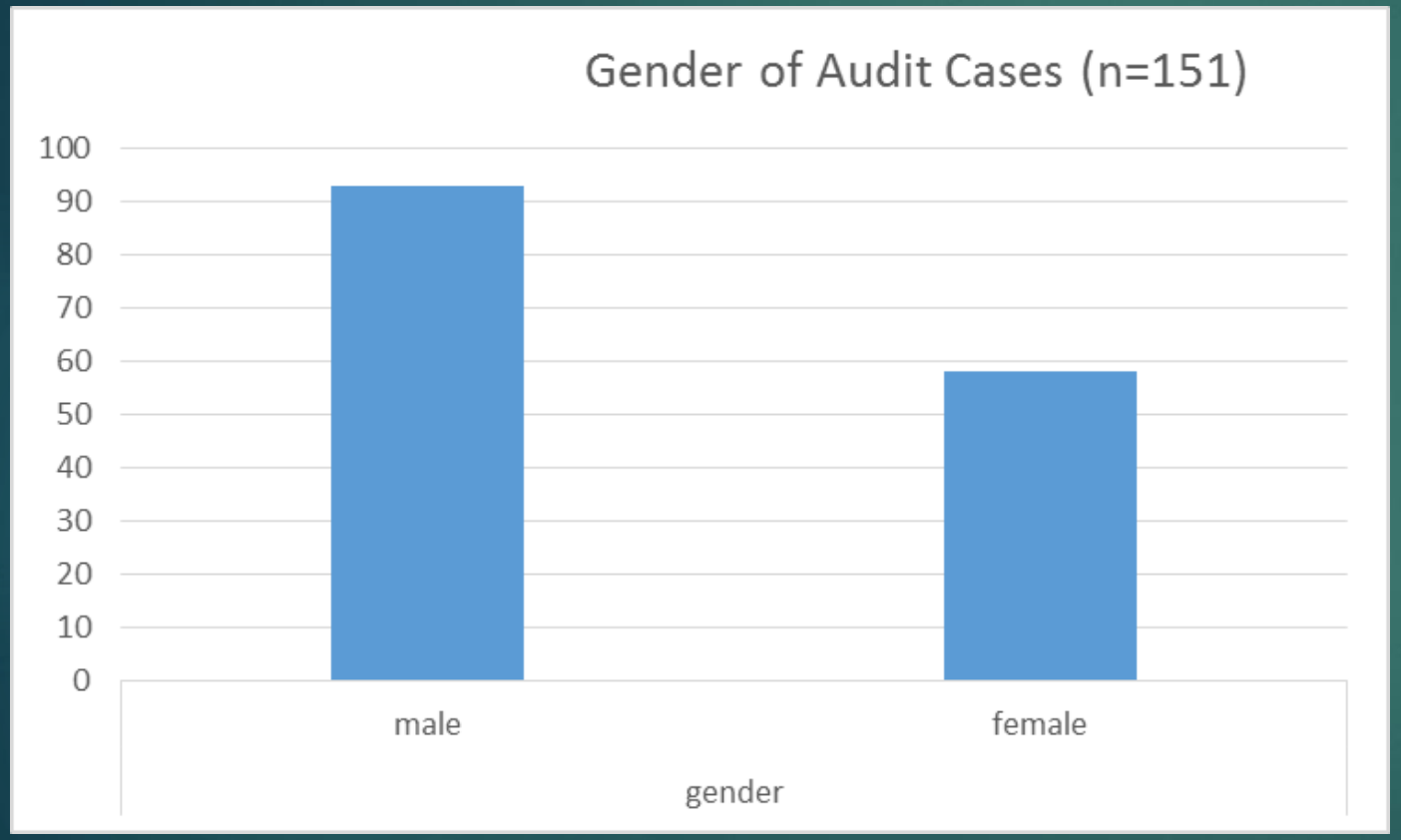
Method

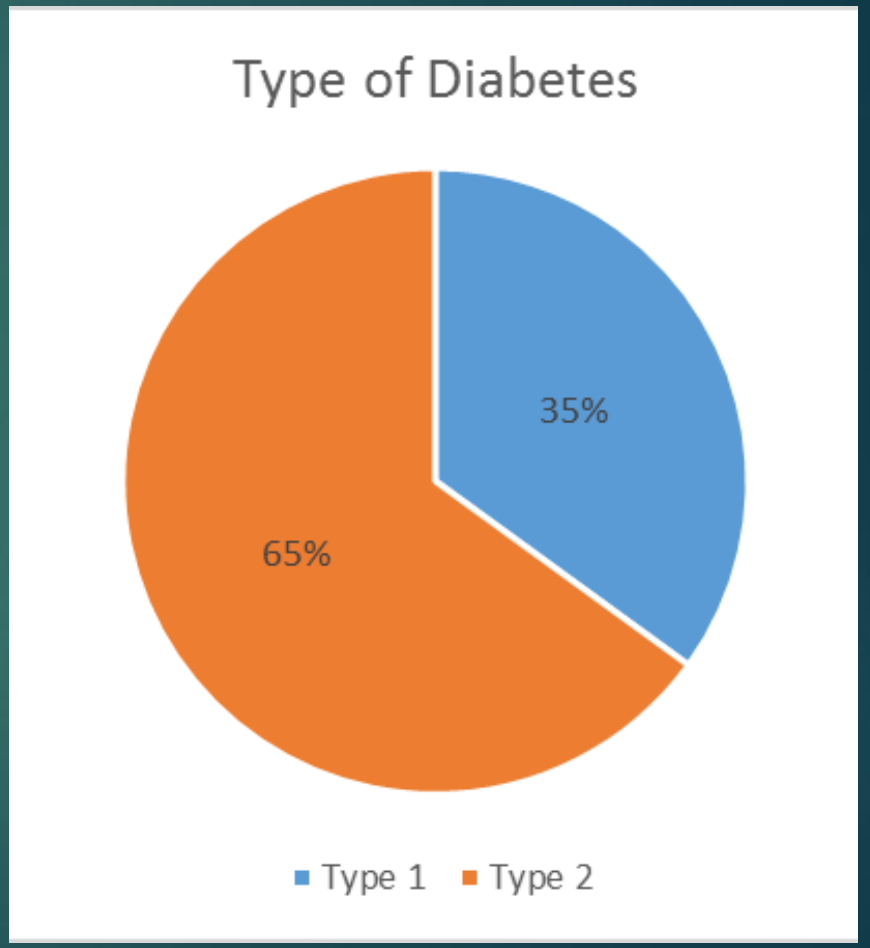
- All R3 cases from Nov 2015-Nov 2016 were extracted from the Optomise database (n=160 patients)
- Demographics collected
- 2 sets of 80 patients were divided between 4 graders (80 each)
- 2 graders looked at each patient's image
- One instructed to look at 2 standard images only and grade R grade only in both eyes
- The other instructed to look at all images taken and grade R grade only in both eyes (gold standard)
- Any discrepancies between them were then evaluated

Results

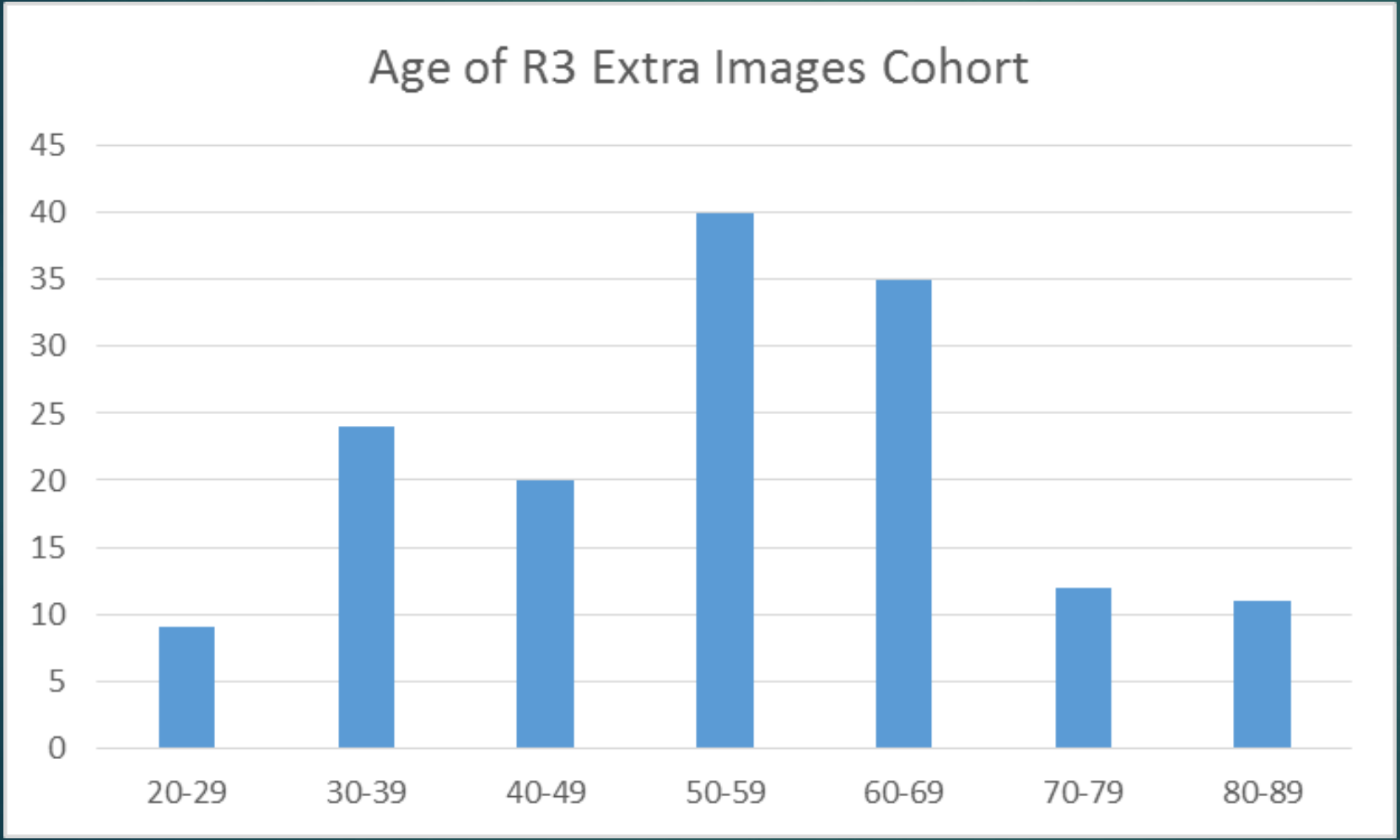
- n=160 patients
- 6 had no extra images taken (all had R3 visible on standard views)
- 2 had no R3 detected in either eye (both graded as R2 by graders)
- 1 was a duplicate
- n=151 patients remaining in cohort for analysis
- Analysed by Eye Grade
- Analysed by referral status (worse grade)

Audit Cohort (n=151)





Age of cohort & Duration of Diabetes

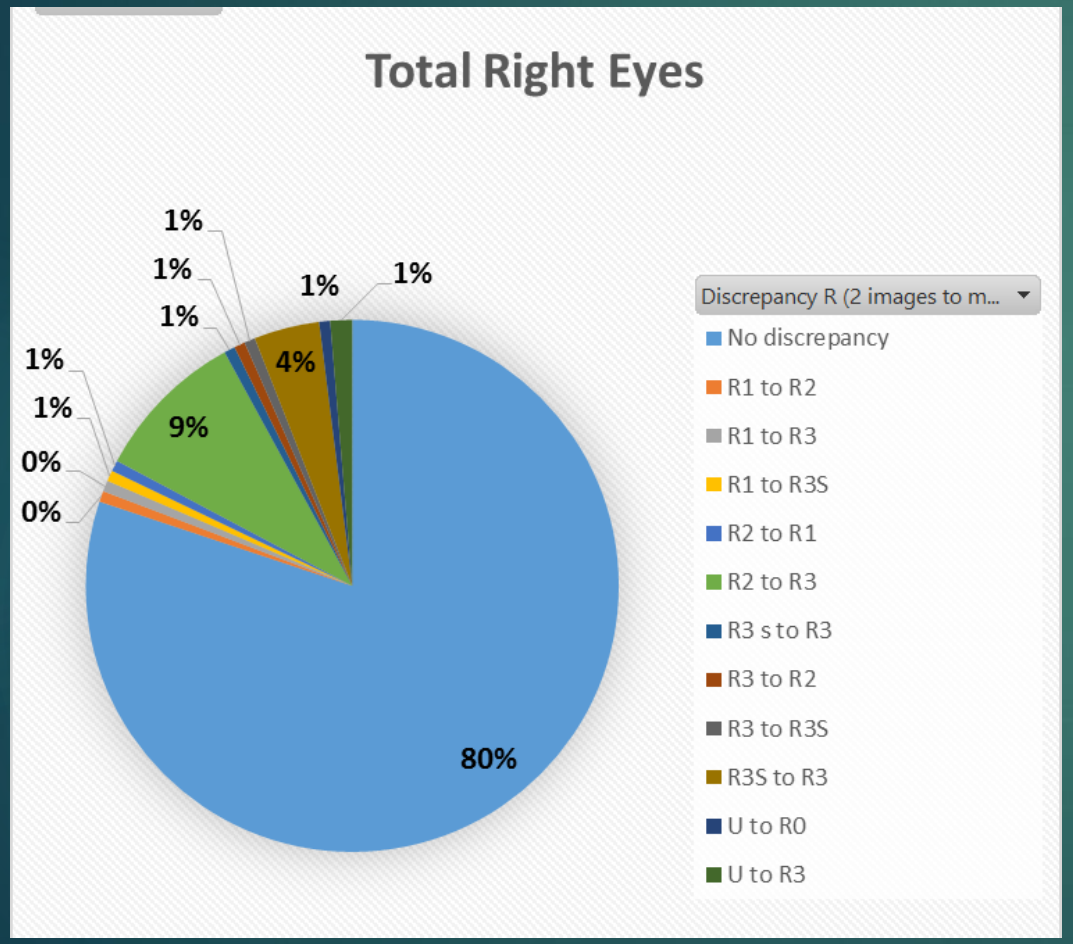


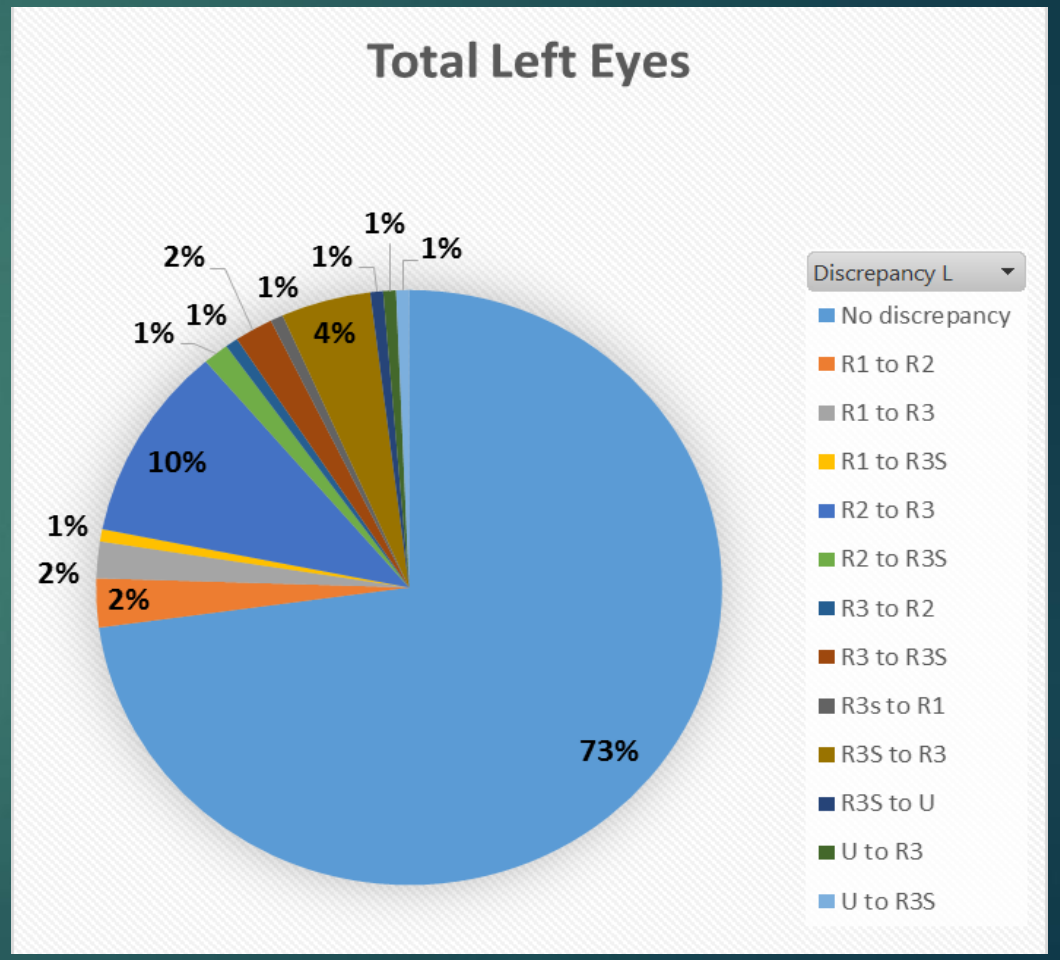
- Average Duration of Diabetes: 23 years
- Range: 15-57 years

Discrepancy by Eye

- Out of 302 eyes graded, in 230 there was no difference between the grading of the 2 standard images compared to that of the extra image set (76%)
- There was a discrepancy in 72 eyes (24%) (31 right and 41 left eyes) between the standard images and extra image sets (n=62).
- In **30 eyes (10%)**, **the R3 was missed by just looking at the "2 standard" images compared to all the images** (29 patients)
- **14 of these patients** would have been referred as **Urgent anyway** due to the fellow eye grade.
- 18 eyes had discrepancies between R3 and R3(S)

Discrepancies by Eye (standard compared to extra images)

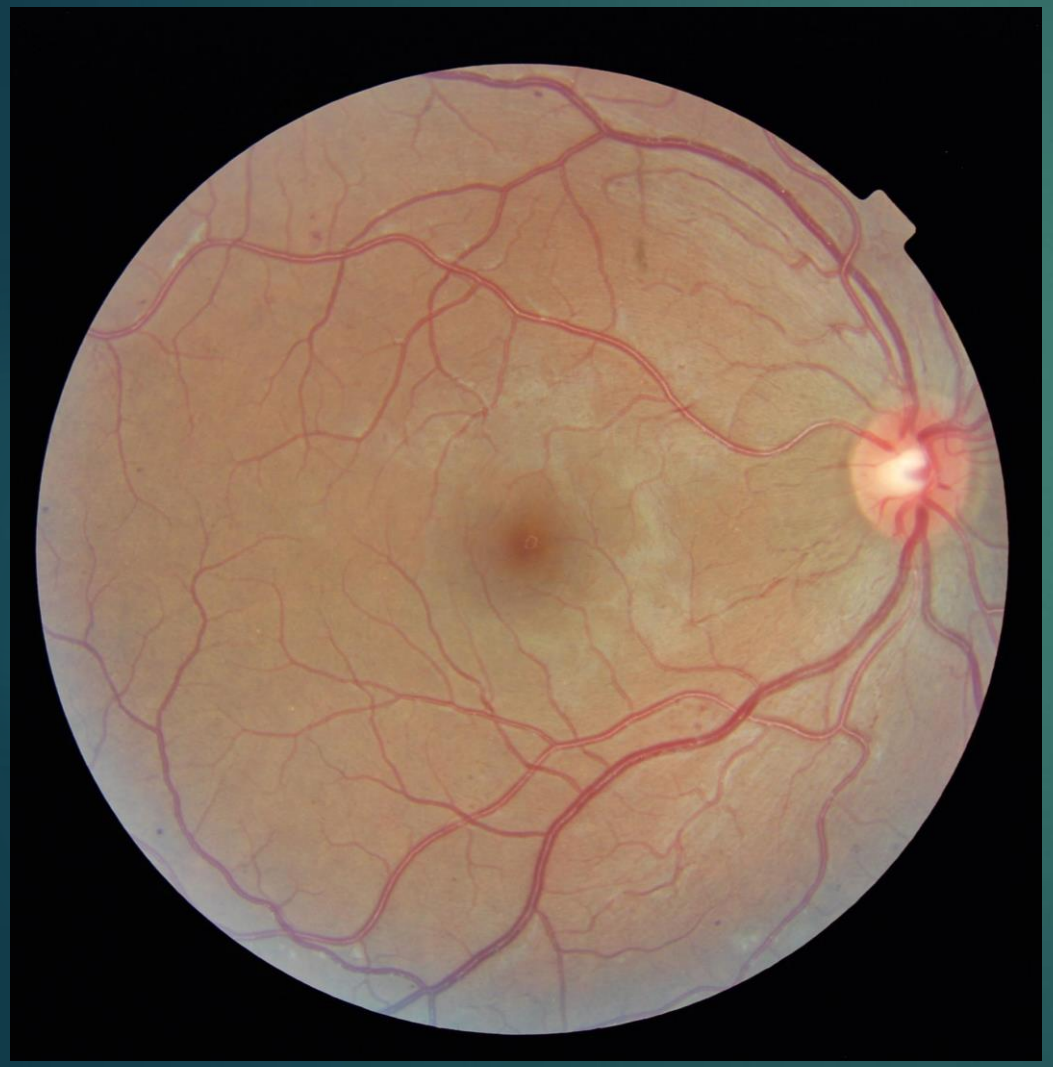




Where were the missed R3's

Location of R3	no
Temporal to macula	7
Inferior to macula	7
Superior to macula	6
nasally	2
Inferior/temporal to disc	2
Temporal to disc	2
Superior & inferior to disc	1
Superior to disc	1
Superior to nasal	1
Superior & inferior to macula	1

Example of missed R3 (nasal)



Sensitivity v Specificity of detecting R3/R3S v non-R3/R3S using 2 standard images only

- Sensitivity = $\frac{\text{True positives}}{\text{True positives + False Negatives}}$

- Specificity = $\frac{\text{True negatives}}{\text{True negatives + false positives}}$

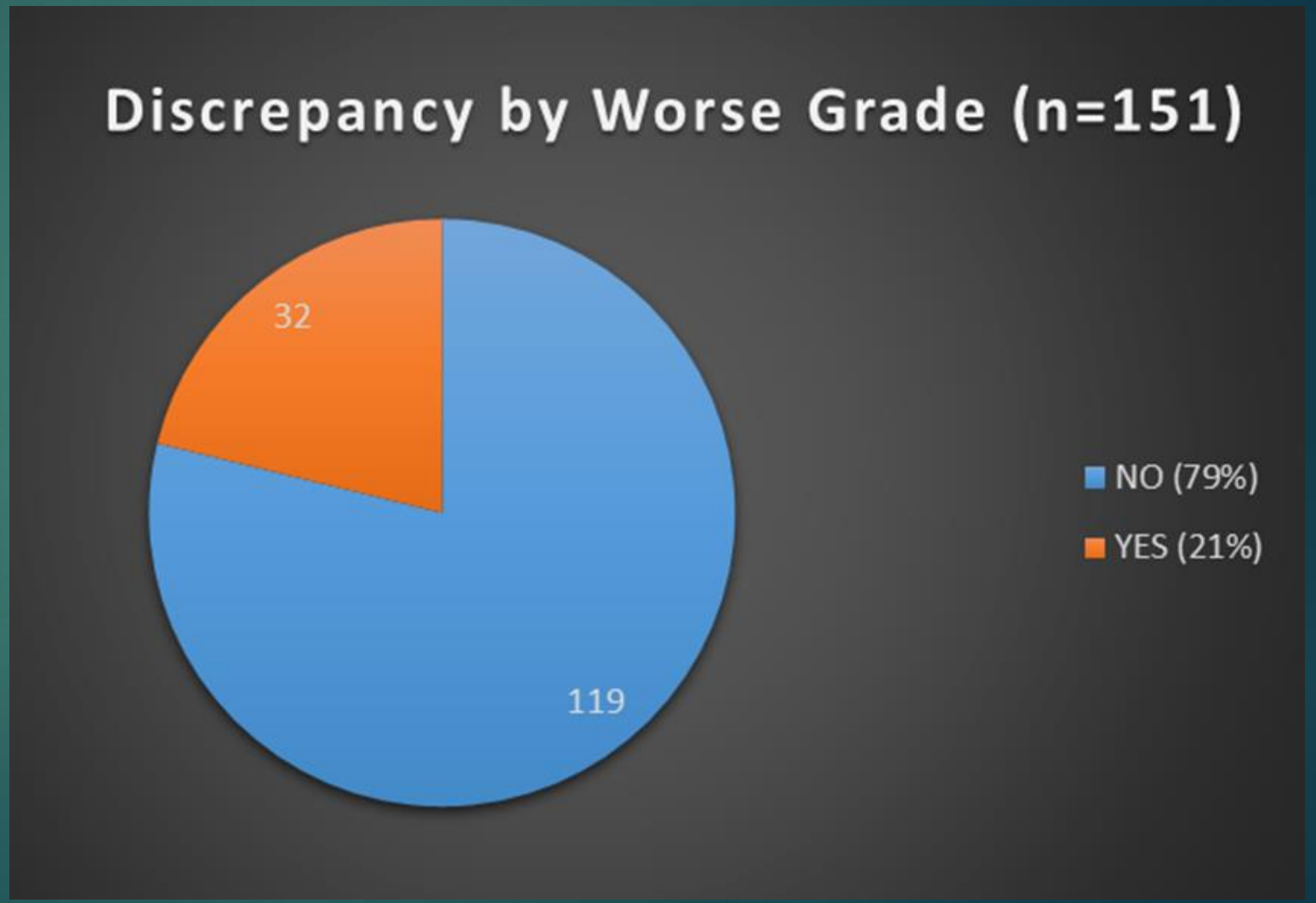
	Gold standard (multiple images)		
2 standard images	**N=302**	R3/R3S	Not R3/ R3S
	R3/R3S	186 (TP)	4 (FP)
	Not R3/R3S	45 (FN)	67 (TN)

Sensitivity= 186/231= 80.5%

Specificity= 67/71= 94%

Discrepancies by Patient (worse grade)

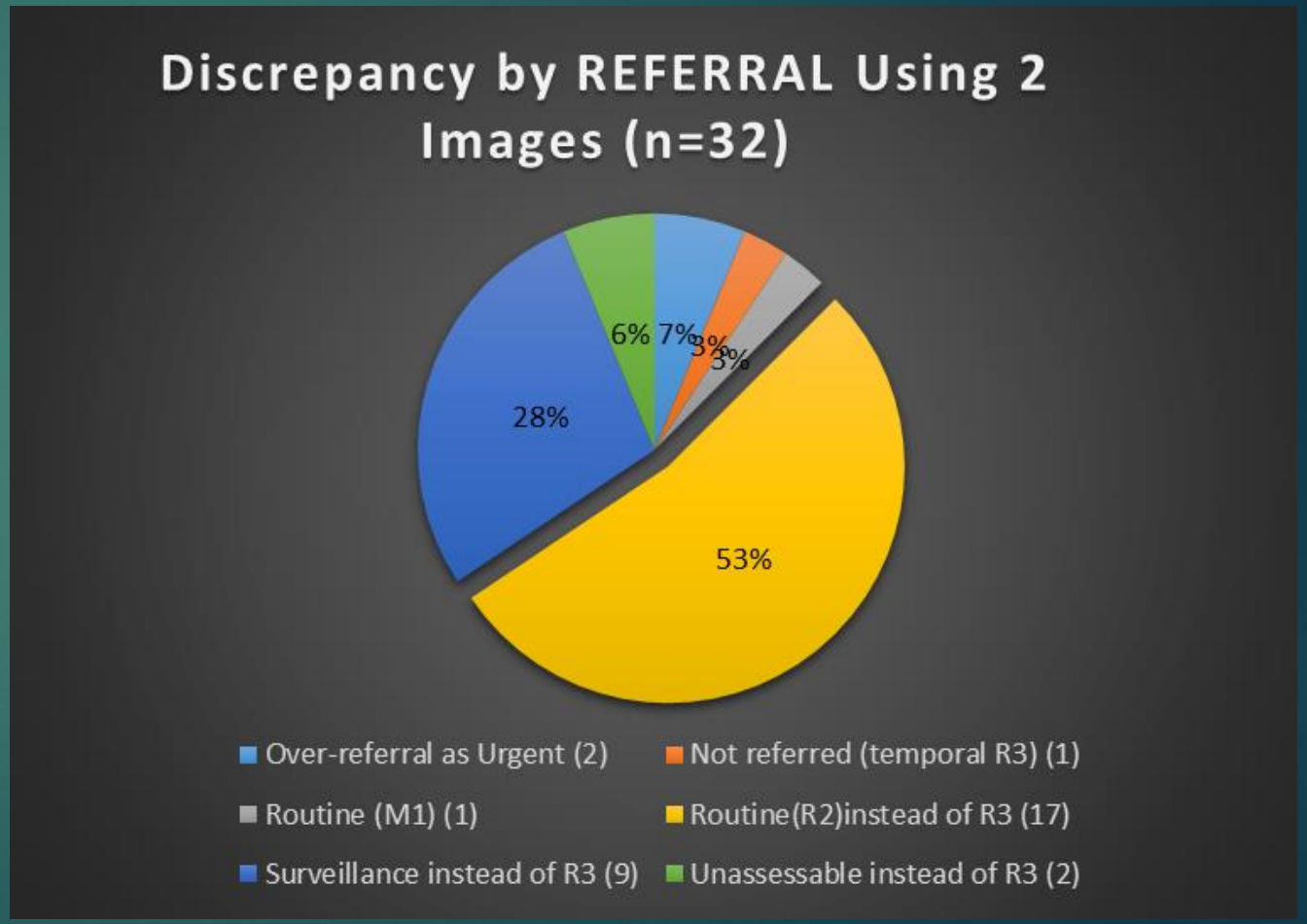
- 151 patients
- No discrepancy in 119/151 (79%)
  - 112 Referred as R3 Urgently as appropriate
- Discrepancy in 32 patients (21%)



Discrepancy by Referral (n=151)using 2 standard images compared to multiple images

- Discrepancy found in 32/151 (21%)

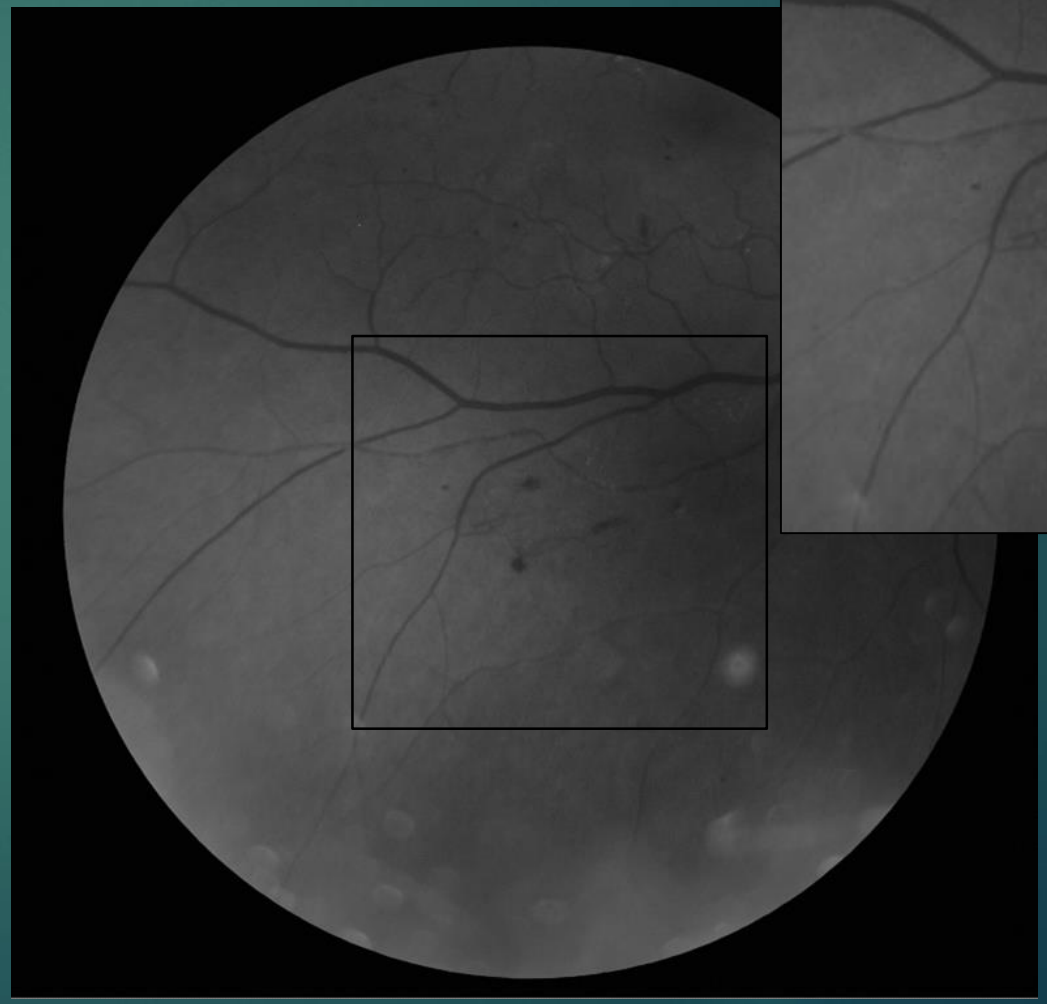
- 2 were overgraded as R3 referred URGENTLY anyway
- 17 were graded as R2 instead of R3 (referred as Routine)- DELAY in referral
- 9 referred to surveillance (R3(S)- DELAY but already had laser
- 2 referred as unassessable- DELAY
- 1 referred as Routine instead (due to M1)- DELAY
- **ONLY 1 NOT REFERRED** (R3 was in temporal area- not seen on standard images)



Examples of missed R3-
Case 1- temporal (not referred)

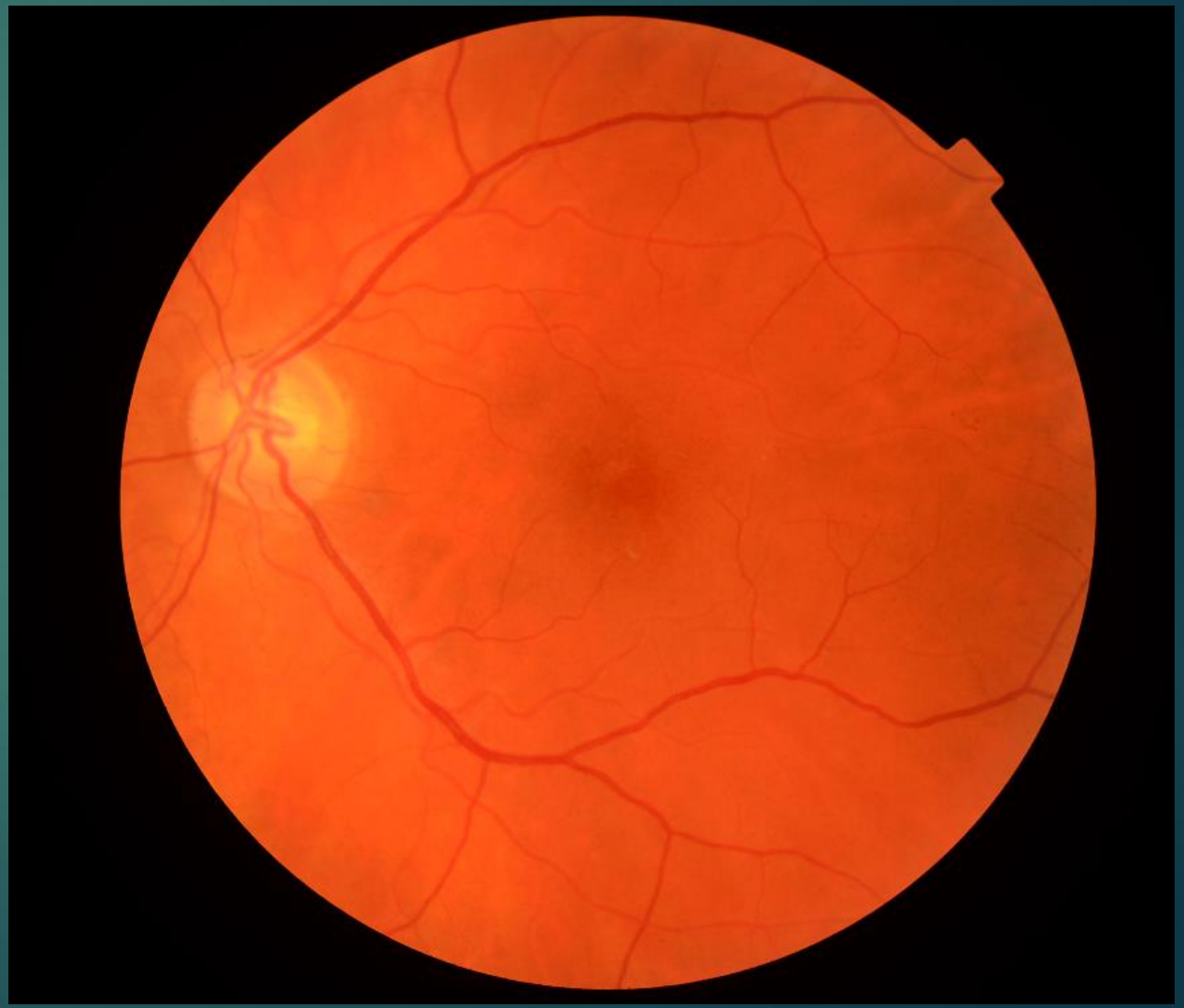
Missed R3 (Inferior R3) Referred with M1

R3 on Extra Images- but would have been referred as routine due to M1



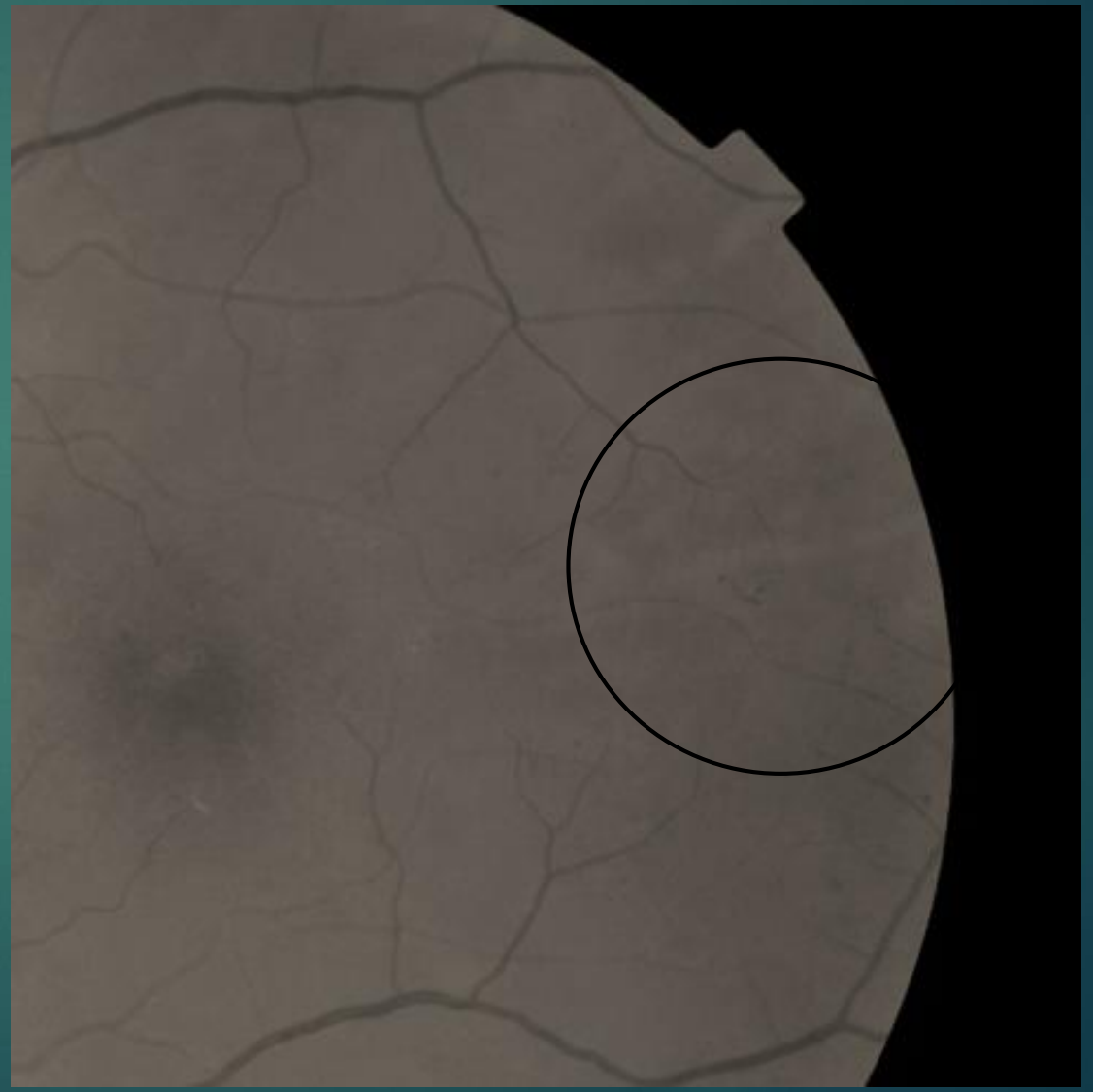
Fellow Eye (graded as R1)

Missed R3 Case

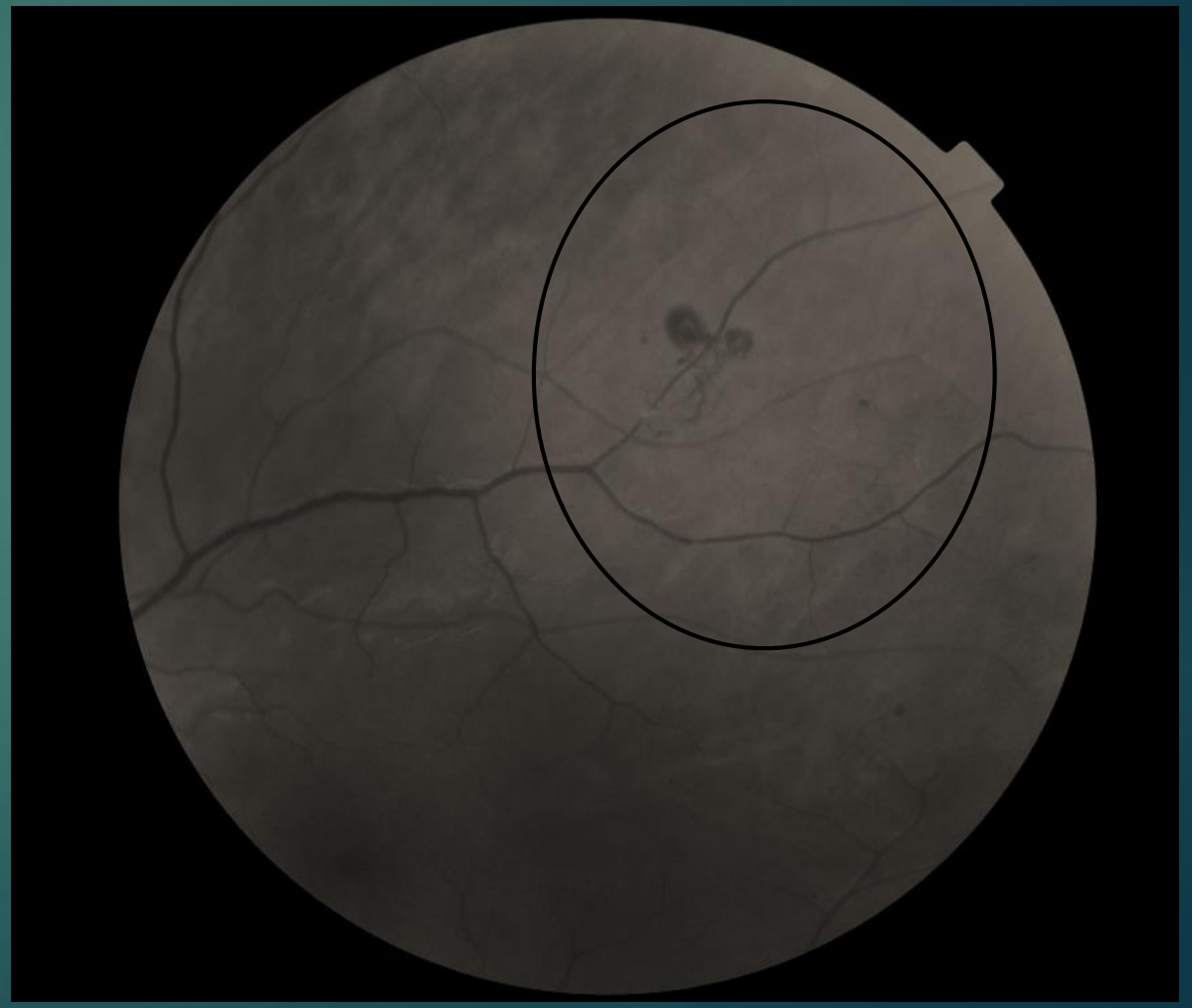


R3 Could have easily been missed (35 yr old type 1)

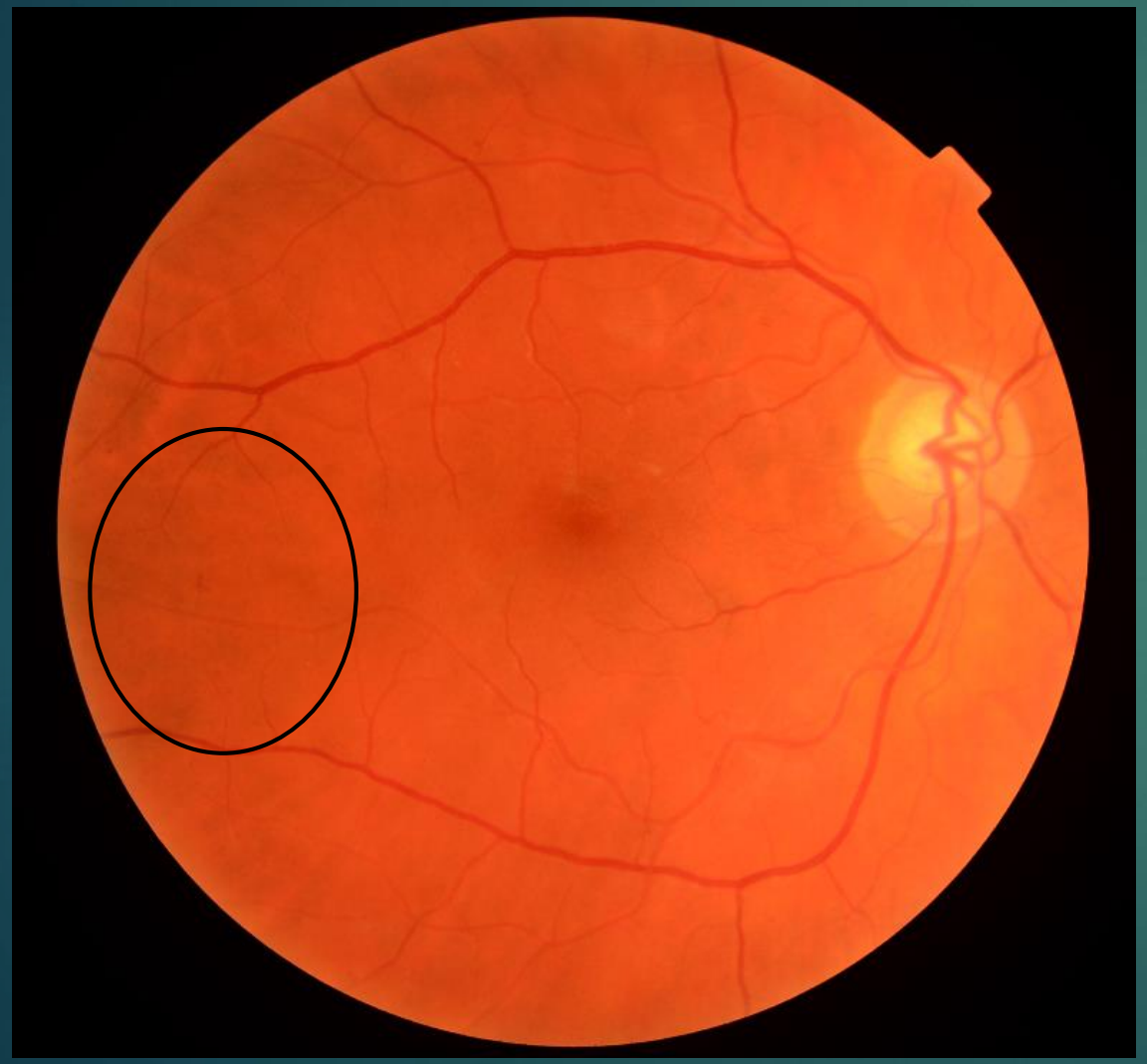
Subtle ?R2 changes on standard images



Extra Images LE- R3 temporally detected more easily



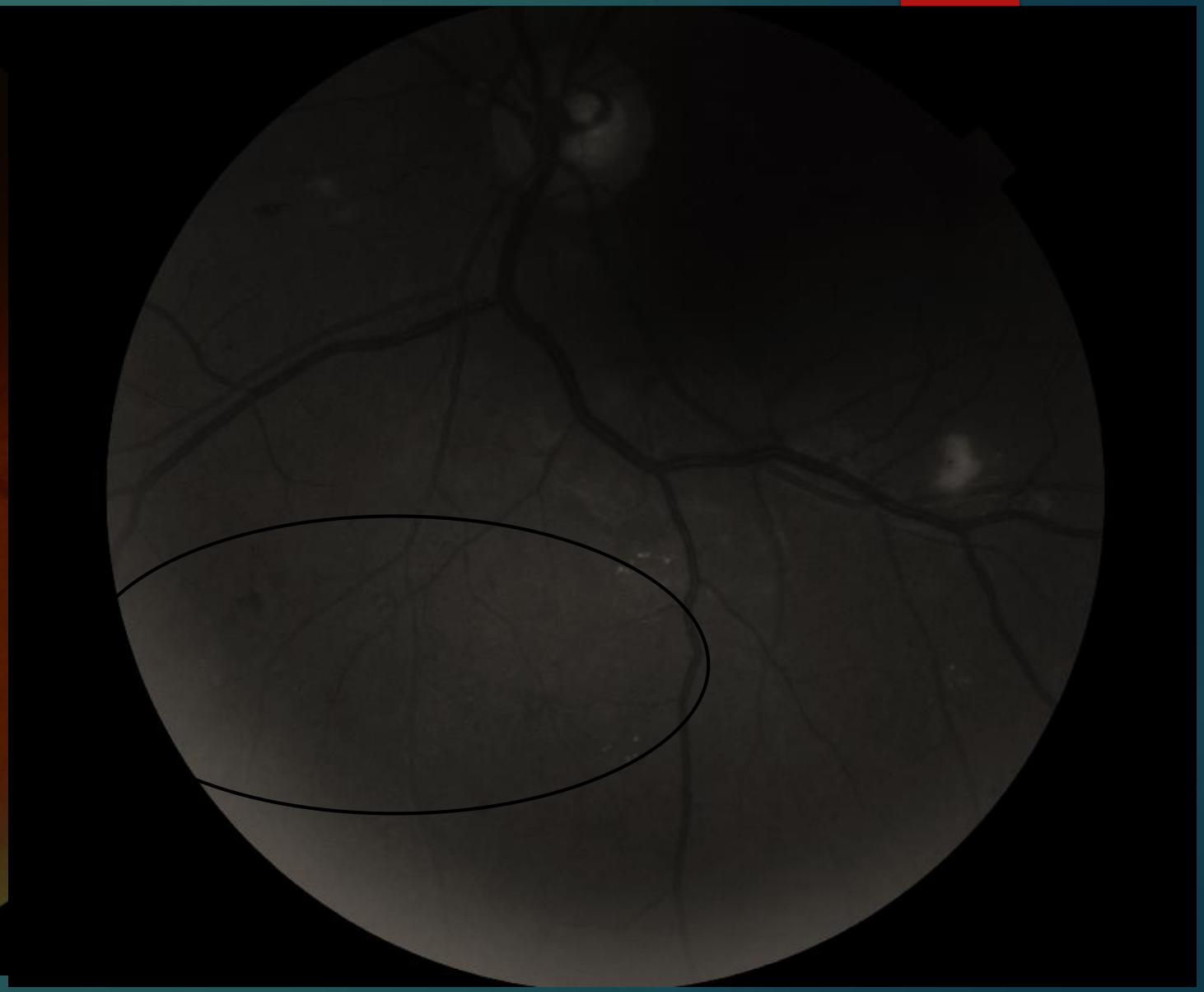
Fellow eye- subtle R3



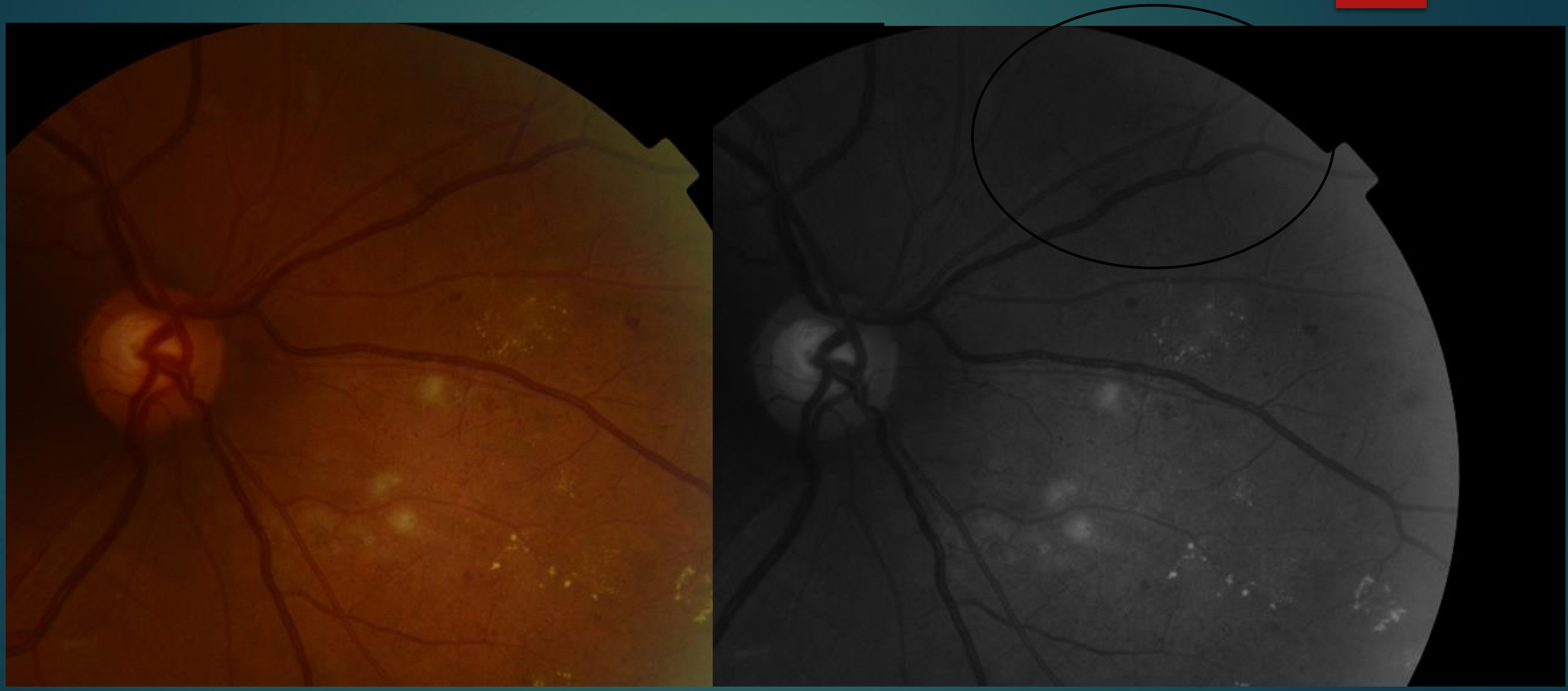
Further R3 case, 39 year old Type 1 (CWS++)

Case 3- graded as R2 on standard images?

R3 on extra images



Further case- Much more subtle to detect (graded R2)



Easier to detect R3 changes on extra images

Conclusion- Should we be taking more than 2 images per eye?

- Ideally YES, as we would detect 10% more R3 cases (30/302 eyes had R3's detected with extra images)
- BUT
- Half (14 eyes) of these would have been referred anyway due to R3 in the fellow eye
- The other cases would have been referred as Routine (R2, M1 or unassessable) instead of Urgent
- Only 1 case would have NOT BEEN REFFERRED (too Temporal pathology)
- The sensitivity and specificity for detecting R3 on 2 images remains high
- There are several disadvantages of taking extra images including extra time taken, delays in grading etc…

Recommendations

- It therefore appears safe to continue to take just 2 images per eye rather than multiple images
- We have to accept that we won't detect as many R3's (10%), may refer more as R2.
- By taking less images, screener/ graders will save time to be able to study the photographs in more detail for subtle pathology and IRMA.
- All patients with R3 had diabetes for >15 years (ave 23 years). An Extra Temporal image in high risk cases may help to pickup further cases of R3 pathology/ especially if "edge" pathology present.

Thank you
Any Questions?

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