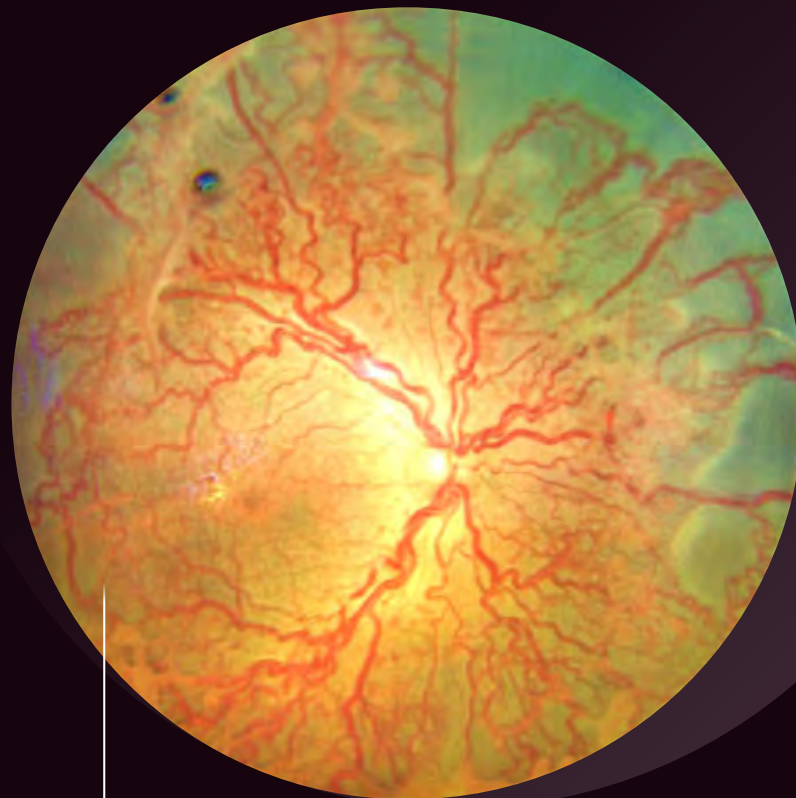


# LVPEI Atlas of Retinopathy of Prematurity and other Neonatal Retinal Diseases

Dr. Akash Belenje &  
Mr. R Ugandhar Reddy

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Shot on ZEISS CLARUS 700  
UWF Fundus Imaging System

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# **LVPEI Atlas of Retinopathy of Prematurity and other Neonatal Retinal Diseases**

## Foreword by

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### **Dr. Subhadra Jalali** Network Director

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**“ Colour are light’s suffering and joy.**

– Johann Wolfgang von Goethe

**”**

Fundus photography is all about the ‘colour’. To differentiate a healthy retina from one which has a problem, and especially to identify distinctive signs of a disease, clinicians depend on pattern recognition both in a busy clinic and during detailed viewing for research and teaching. While a high resolution and a widefield of view are a pre-requisite to get all the information, the true colours are an important component for accurate interpretation and diagnosis. In newborn babies, additional critical components include the safety, the speed, and the ease of image acquisition including a non-contact system. The ZEISS CLARUS 700 which uses true colour reflectance imaging with high resolution and a non-contact approach, hence has a great potential for fundus photography of newborn babies in addition to its current usefulness in adult retinal diseases.

Imaging the retina becomes important in Retinopathy of Prematurity (ROP) not only for documentation, follow-up, teleconsultation, sharing with parents and for teaching students, but also from medico-legal perspectives. Taking fundus photographs of tiny babies is not an easy task; and requires ‘tender handling coupled with efficient technology’. Commonly used neonatal fundus imaging systems, however, may not be affordable, may have logistic challenges, cannot be used in immediate postoperative period, could be out of order when that one important image is to be taken or may not be feasible in clinics with low volumes. Most of the dedicated neonatal fundus cameras are ‘contact’ systems and

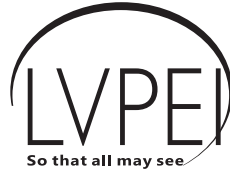
the 'pseudo-colours' in some cameras can camouflage the true nature of the disease especially in periphery of the retina or have peripheral artifacts.

The ZEISS CLARUS 700 imaging system lends itself readily to neonatal retinal imaging. The learning curve for technicians is brief, though rigorous. The fast rate of image acquisition and non-contact nature are comfortable and safe for the baby. The technique uses 'flying baby position'—a technique which was described in the literature almost 50 years ago for slit-lamp evaluation of babies; this technique is comfortable and efficient.

The atlas contains 100 ROP images of varying disease severity and in different clinical situations. The true colour reflectance images with high resolution provide a wonderful opportunity to see the entire spectrum of ROP presentations, follow-up, pre and post treatment and its natural history. One can also see ultra-widfield images when 2 images are stitched together into a composite image of 200-degree wide and 133-degree high field of view.

Anant Bajaj Retina Institute diagnostic team under the leadership of Dr. Akash Belenje and Mr. R Ugandhar Reddy have demonstrated in this atlas something unique and is published for the very first time! They have gained expertise and experience

in using the ZEISS CLARUS 700 fundus photography for the tiny, vulnerable preterm babies reporting to the L V Prasad Eye Institute. With due diligence and systematic methodology, they have put together these photographs which I envisage will be of immense benefit to clinicians, researchers, students, parents, health communicators and policy makers. The atlas showcasing true colour fundus imaging of ROP babies fills the gap of neonatal fundus photography in our routine retina clinics without need for additional equipment, space, or human resource. We look forward to more retina specialists being able to extend the facility of fundus photography to the preterm babies as part of their routine retina clinic services and using this atlas to educate parents, students, donors and health policy makers.



## LV Prasad Eye Institute

The L V Prasad Eye Institute (LVPEI) is a comprehensive eye health network headquartered in Hyderabad, Telangana, India. It is a World Health Organization (WHO) collaborating centre for the prevention of blindness and one of the leading eye care facilities in the world.

LVPEI was founded in 1987. Today, it is one of the world's largest integrated eye care service delivery networks. It is also home to first-rate basic eye care as well as clinical research, and thrives in translating cutting-edge research into effective clinical and surgical practice. It is a hub of innovation that seeds new-age eye care products and technologies. LVPEI pioneered an integrated pyramidal model of eye care delivery that brought full-fledged, high-quality, cross-subsidized eye care services to the reach of over 34 million people in over three decades. Every year, the LVPEI network services over 1.5 million outpatients, performs nearly 150,000 surgeries, and trains over 15,000 eye care professionals. Over half of all services are free to those who cannot afford them. This is enabled by a system of cross-subsidy that has helped LVPEI support communities that are too sparse to sustain permanent facilities. Despite its scale, LVPEI offers eye care services that are integrated, people-centric, and comprehensive.

LVPEI delivers on these volumes through a network of 266 (and growing) centres of eye care facilities in four states of southern India. The network spans all service levels and is delivered through a multi-tier, pyramidal model of care: from primary to advanced tertiary. The apex of the pyramid is a centre of excellence in Hyderabad. There are three tertiary eye care facilities in Bhubaneswar (Odisha), Vijayawada, and Visakhapatnam (both in Andhra Pradesh). 26 secondary centres (including four urban facilities) support a network of 236 primary care 'vision centres' that serve a population of 50,000 people each. It is estimated that the current pyramidal network can service the eye care needs of 150 million people.

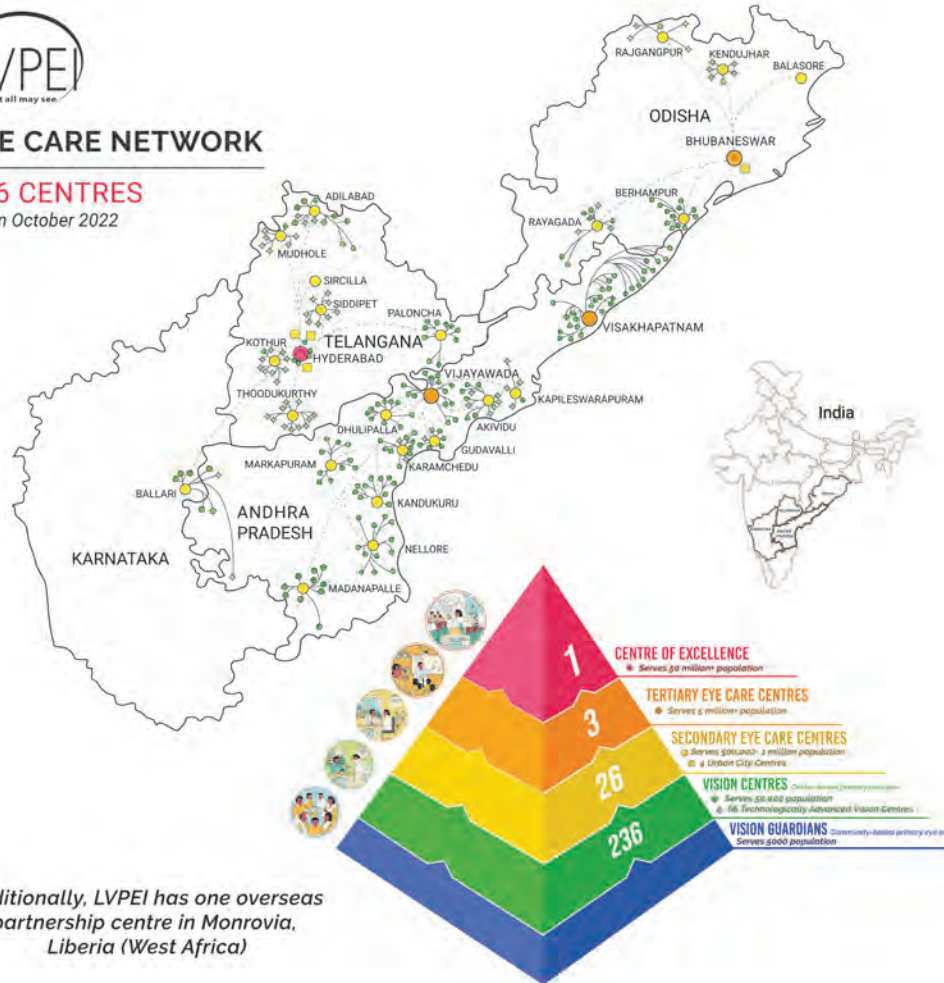
The Anant Bajaj Retina Institute is an 'Institute of Excellence' focusing on retinal diseases at LVPEI. The institute offers high-quality retinal services to the millions who access the LVPEI network and benefit from LVPEI's alumni and partner networks. It is also a global resource centre for retinal diseases focusing on capacity building, promoting and enhancing research capacity in India and other developing countries, scaling up community eye health programs, and utilizing technology for the better care of retinal diseases.



## EYE CARE NETWORK

**266 CENTRES**

As on October 2022



Additionally, LVPEI has one overseas partnership centre in Monrovia, Liberia (West Africa)

## Authors

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**“ The story of ROP has never been captured before with such pristine clarity. For the very first time we welcome you to the world of ROP in true colours. ”**



# Dedication

## Dedicated to all preterm babies

You are a precious gem, the apple of one's eye, born too soon and you had to face so many obstacles, yet your fighting spirit and perseverance is something we must all learn from. It's time we tell the world your true story, it's time we reduce ROP burden.



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## **Abbreviations**

**APROP** – Aggressive Posterior Retinopathy of Prematurity

**Anti-VEGF** – Anti-Vascular Endothelial Growth Factor

**NC-WFI** – Non-Contact Widefield Imaging

**LSV** – Lens Sparing Vitrectomy

**ROP** – Retinopathy of Prematurity

# **Retinopathy of Prematurity (ROP)**

## Retinopathy of Prematurity

Retinopathy of Prematurity (ROP) is an eye disease that could happen in babies born early (premature) or who often, though not always, weigh less than 2000 grams at birth. ROP occurs when abnormal blood vessels grow in the retina. Some babies with ROP have mild disease and get better without treatment. But some babies need treatment to protect their vision and prevent blindness.

ROP is a disease of the blood vessels of the retina. The retinal blood vessels begin to develop in babies at about 16 weeks of pregnancy, from the posterior to the anterior part of the eye, and gradually cover the retina evenly. The process is complete just before the birth at full term. In a premature baby, the retinal vessel formation is incomplete at birth and continues to form after birth. Most of the time, these will form normally; ROP occurs when the smaller abnormal vessels develop and gradually detach the retina.

ROP is an emerging epidemic of the 21st century and is attributed to increased premature deliveries, often associated with teenage pregnancies, malnourished mothers, assisted fertilization, and delayed pregnancies. The increased survival of extremely preterm babies due to improved neonatal intensive care facilities across the globe provides the perfect setting for

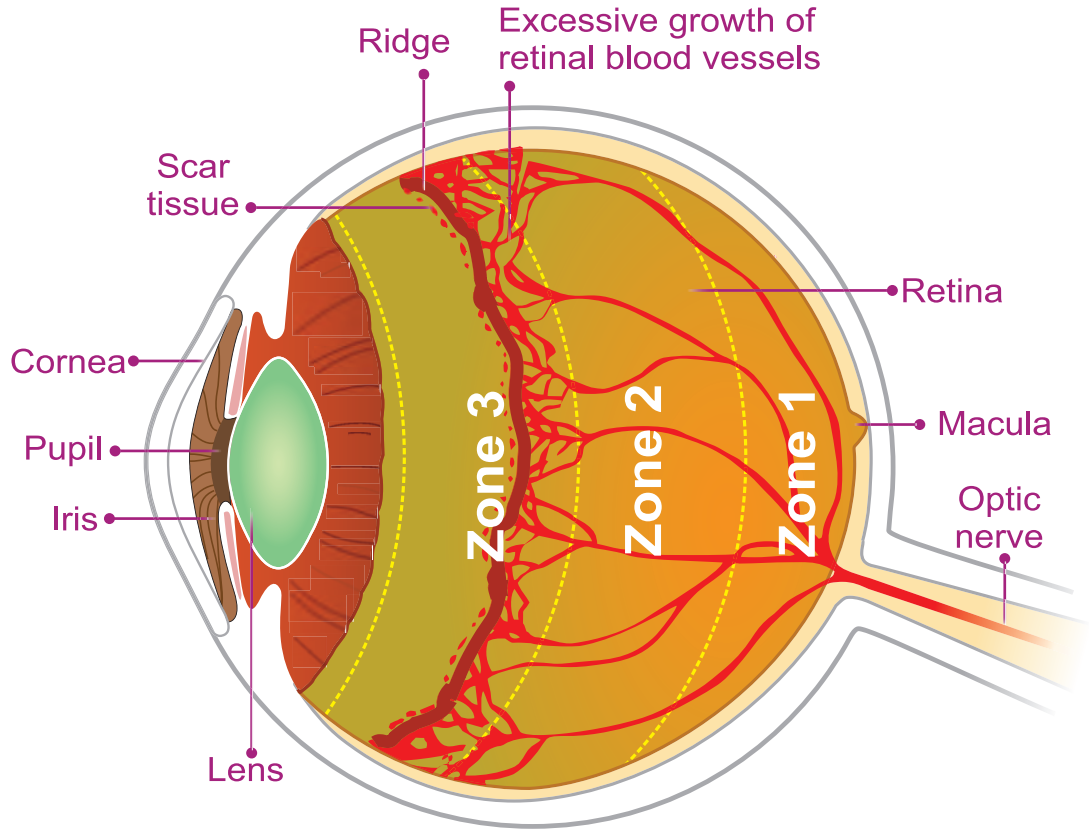
the increased numbers of babies at risk of ROP blindness. While prematurity alone is enough to cause ROP, certain risk factors lead to more severe disease. These are suboptimal antenatal care, suboptimal labour room practices such as immediate cord clamping and giving oxygen to every baby irrespective of the need, suboptimal neonatal care, particularly unmonitored 100 percent unblended supplemental oxygen, anaemia (<10 grams/dL), neonatal respiratory distress syndrome, and neonatal sepsis. The important maternal risk factors for developing ROP in babies are preeclampsia, oligohydramnios, maternal infections like chorioamnionitis, and multiple pregnancies. Many countries/regions have developed National and Regional guidelines to provide ROP screening and management protocols.

**ROP is a rapidly progressive, time-bound disease that is not present at birth but develops over a few weeks. The condition is characterised by the development of abnormally proliferating new vessels in the retina, leading to tractional retinal detachment and vision loss. ROP typically starts 3 to 4 weeks after birth, providing a window for screening and initiating treatment at the right time before it progresses in the next few weeks to a stage of retinal detachment**

**that results in incurable blindness. Timely screening of all premature-born at-risk babies and timely intervention with adequate follow-up care can prevent the sight-threatening consequences of ROP.**

Timely and frequent examination of the retina of the new-born after pupillary dilatation is the key step to identifying ROP, modifying risk factors to reduce prevalence and severity, administering treatment, monitoring the disease status, and dealing with any adverse events at the earliest. Since the retina is not visible from the outside, this must be done by trained healthcare experts who can either examine the retina thoroughly with an ophthalmoscope or take high-quality photographs of the retina for evaluation by doctors. Hence, imaging the new-born retina is critical in diagnosing and treating ROP.

ROP is described by "Zone" and "Stage."





There are three Zones - 1 to 3, and five Stages - 1 to 5. The retinal vessels go from Zone 1 to 3, and disease severity increases from Stage 1 to 5.

**Stage 1 ROP:** It is characterised by a thin line between the area with blood vessels and without blood vessels. At this Stage, the vessels may grow normally though the baby would need frequent retinal examinations.

**Stage 2 ROP:** It is characterised by a ridge, the thickening of the line between the areas with and without blood vessels. It indicates that the disease is progressing and may need treatment.

**Stage 3 ROP:** The new blood vessels begin to grow along the ridge and extend into the vitreous. These blood vessels can

bleed and form scar tissue and need urgent treatment in most cases.

**Stage 4A ROP:** The abnormal blood vessels and scar tissue pull on the retina and partially detach it. This condition needs urgent surgery.

**Stage 4B ROP:** The retina is still only partially detached, but the fovea is affected. Immediate Surgery can salvage some vision in some eyes.

**Stage 5 ROP:** The retina is completely detached, severely affecting vision.

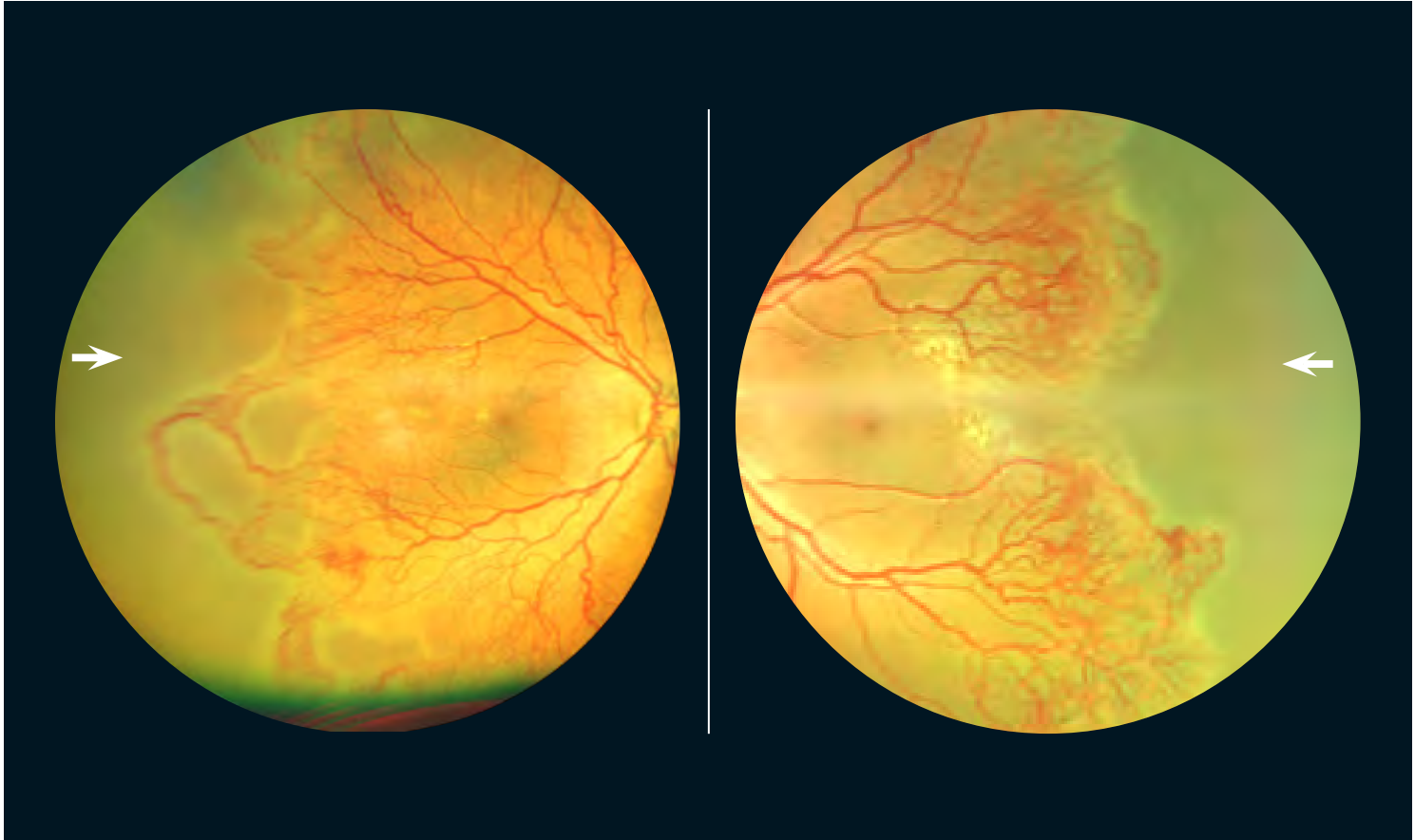
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The World Health Organisation (WHO) celebrates World Prematurity Day every year on 17th November to address all the challenges of preterm babies. Reducing the ROP burden worldwide by a timely screening of every prematurely born baby and appropriate intervention is one of their prime goals. In India, the famous slogan to create awareness is “**#Tees Din Roshni Ke**” (Thirty days to light) which reiterates the golden message that to retain good vision, **every preterm baby must have the first eye (retinal) screening for ROP done not later than 30 days of life!**

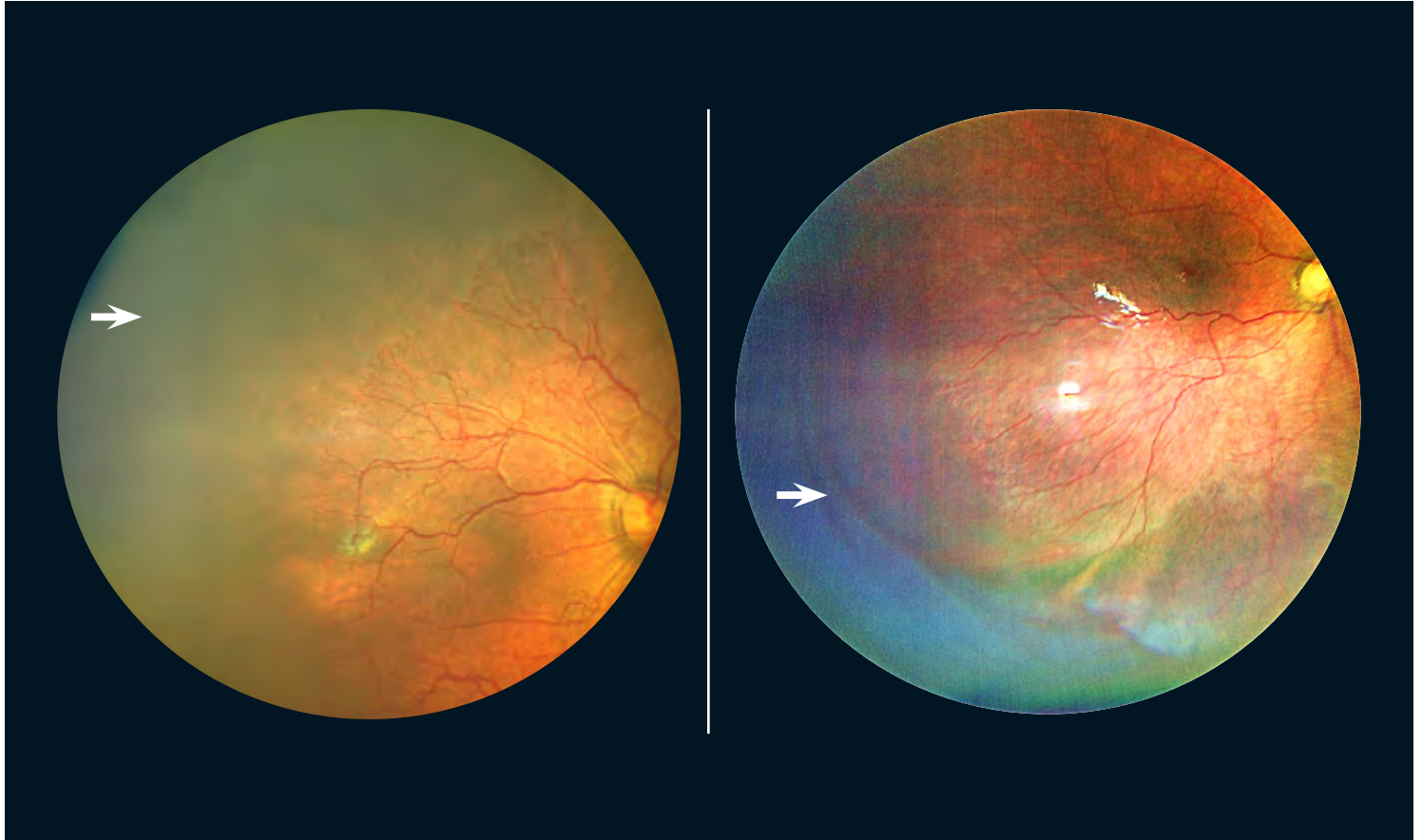


# Index Findings

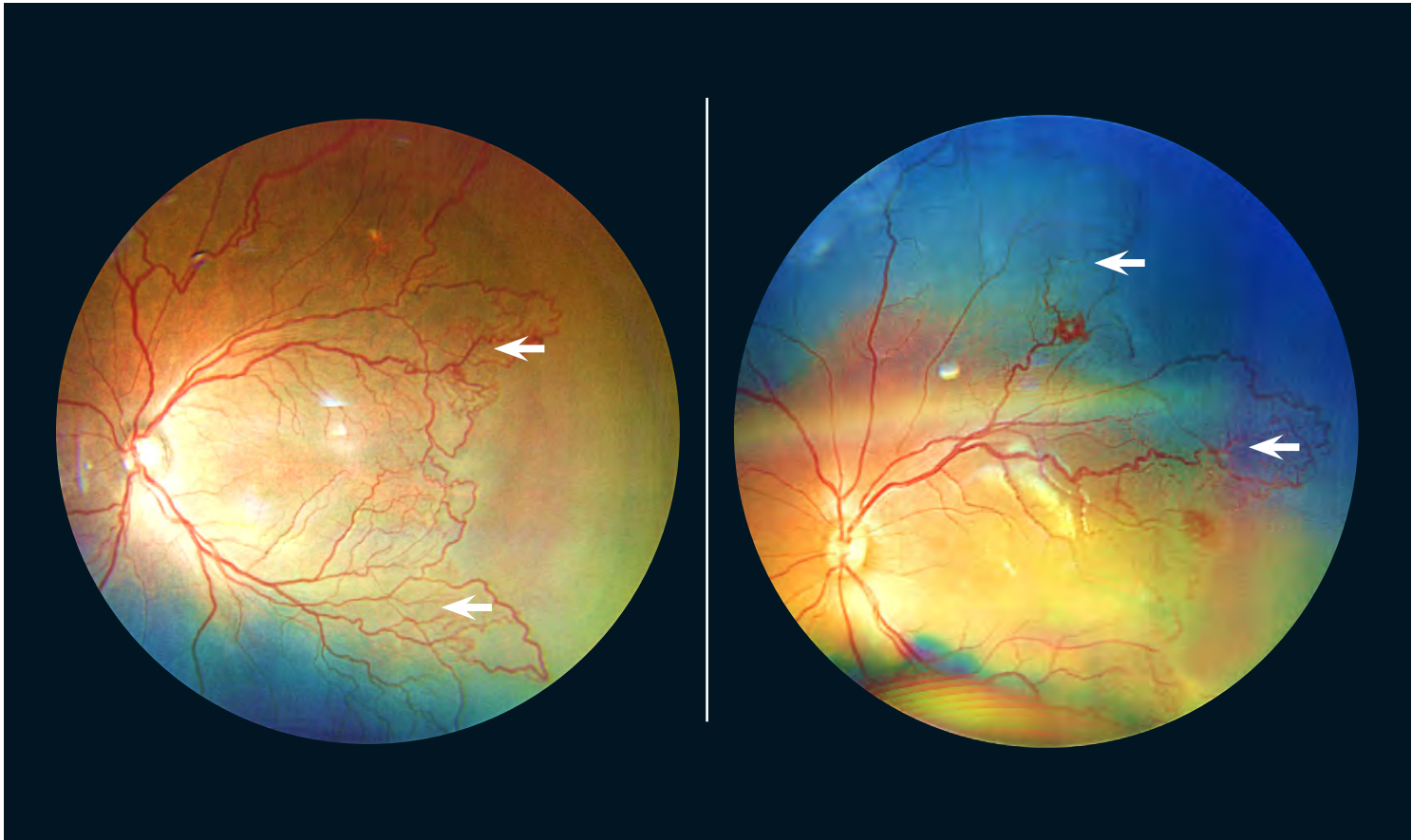
Avascular retina (absence of retinal blood vessels) indicated by arrow



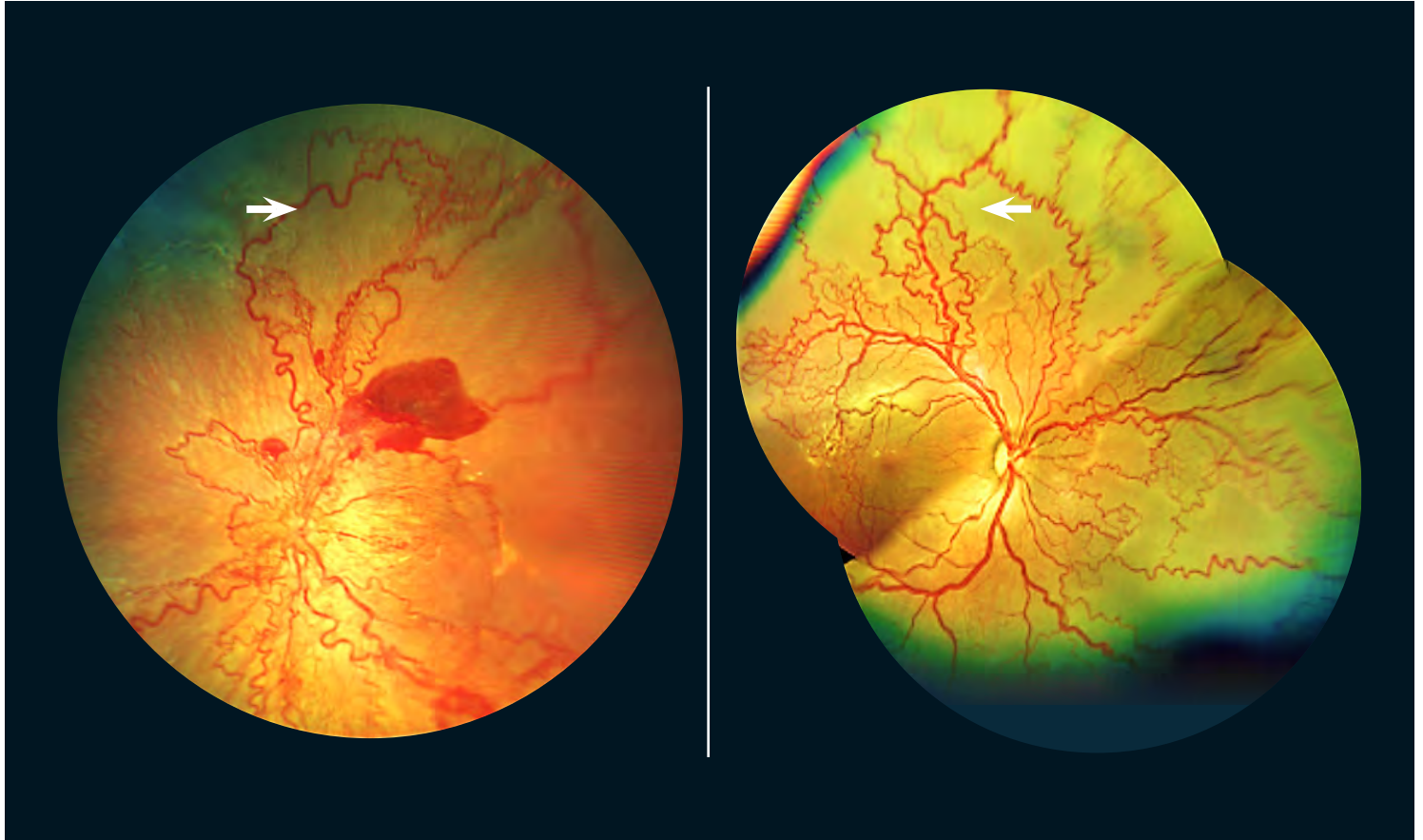
Avascular retina (absence of retinal blood vessels) indicated by arrow



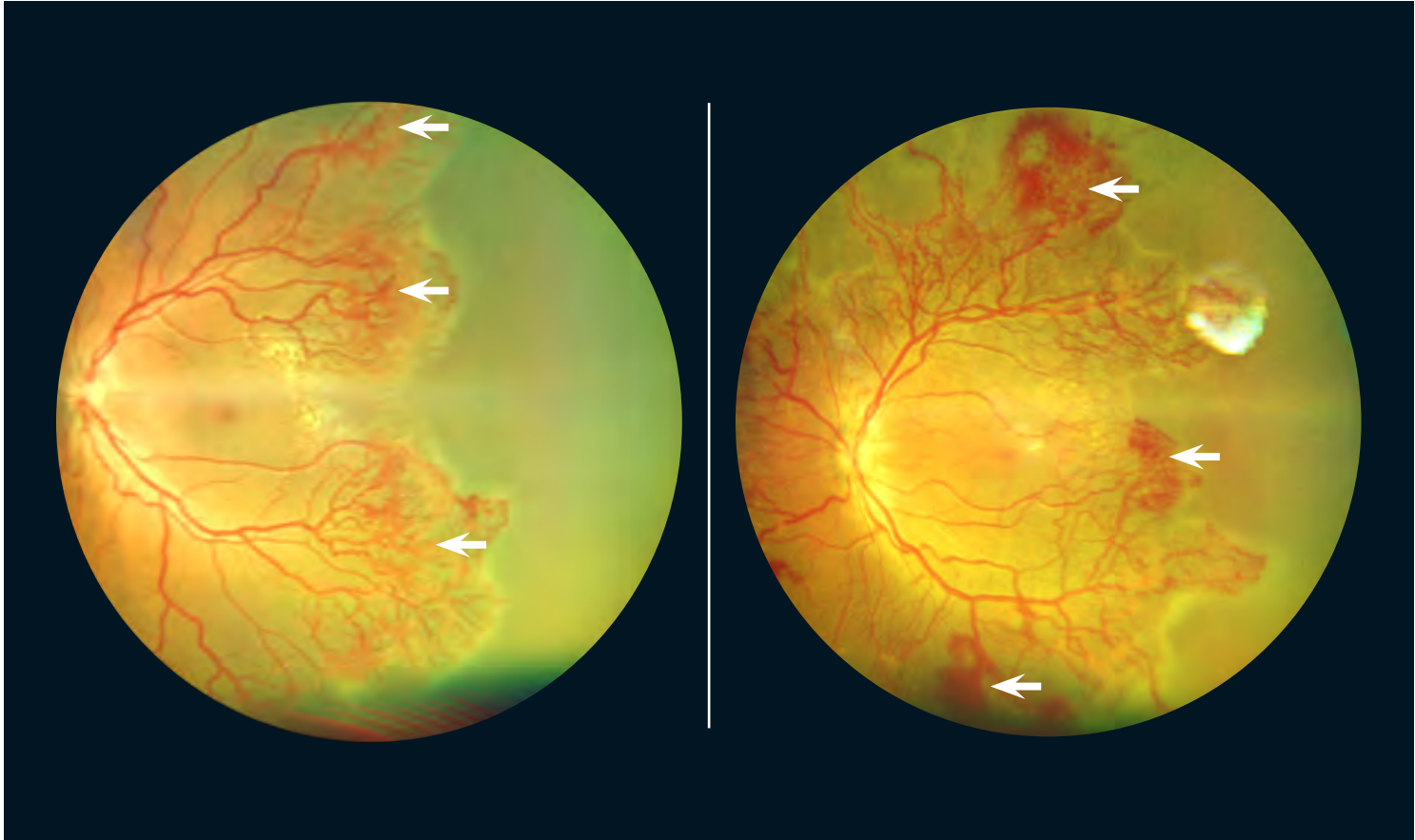
Looping and shunting of vessels indicated by arrow



Looping and shunting of vessels indicated by arrow

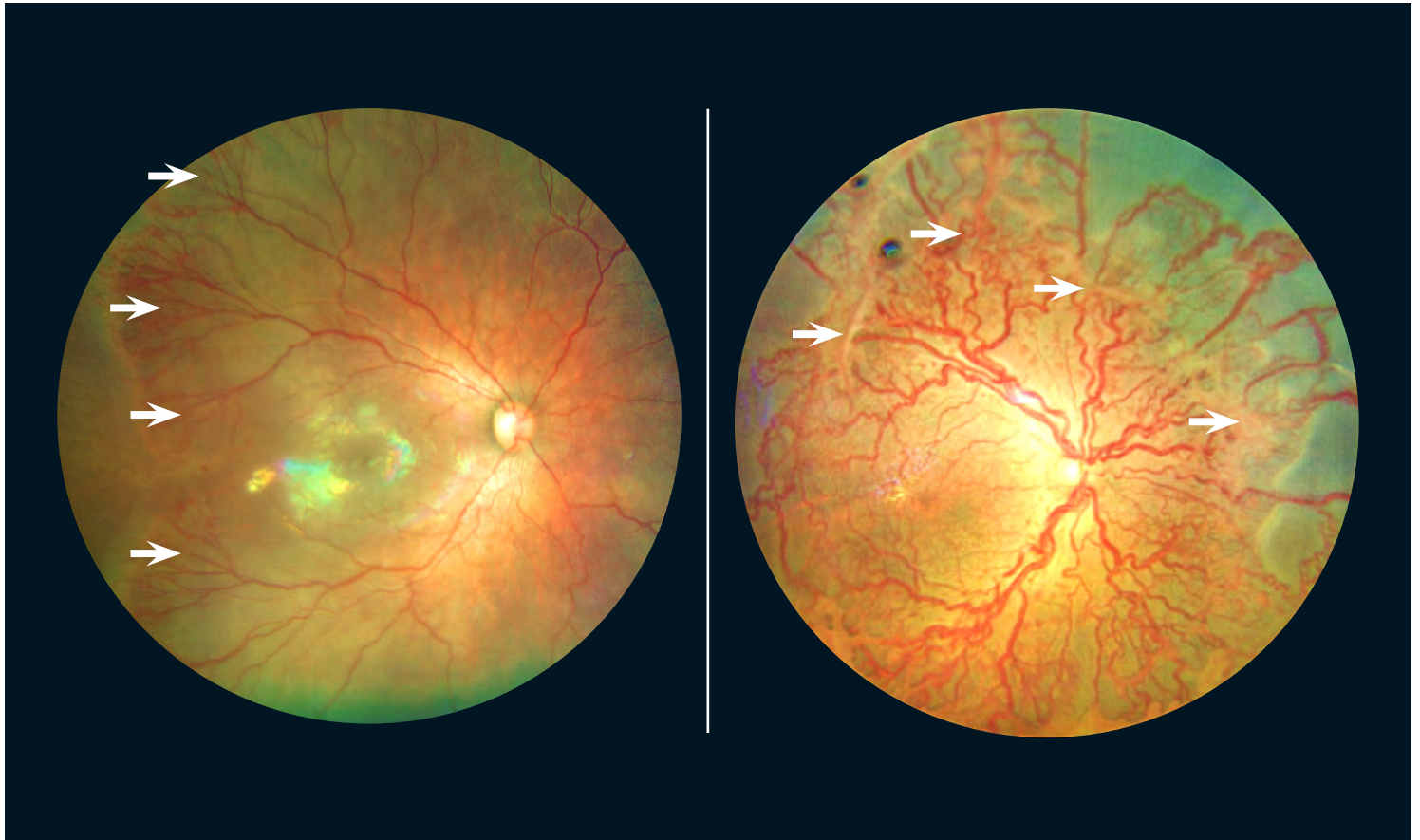


Neovascular fronds / tufts indicated by arrow

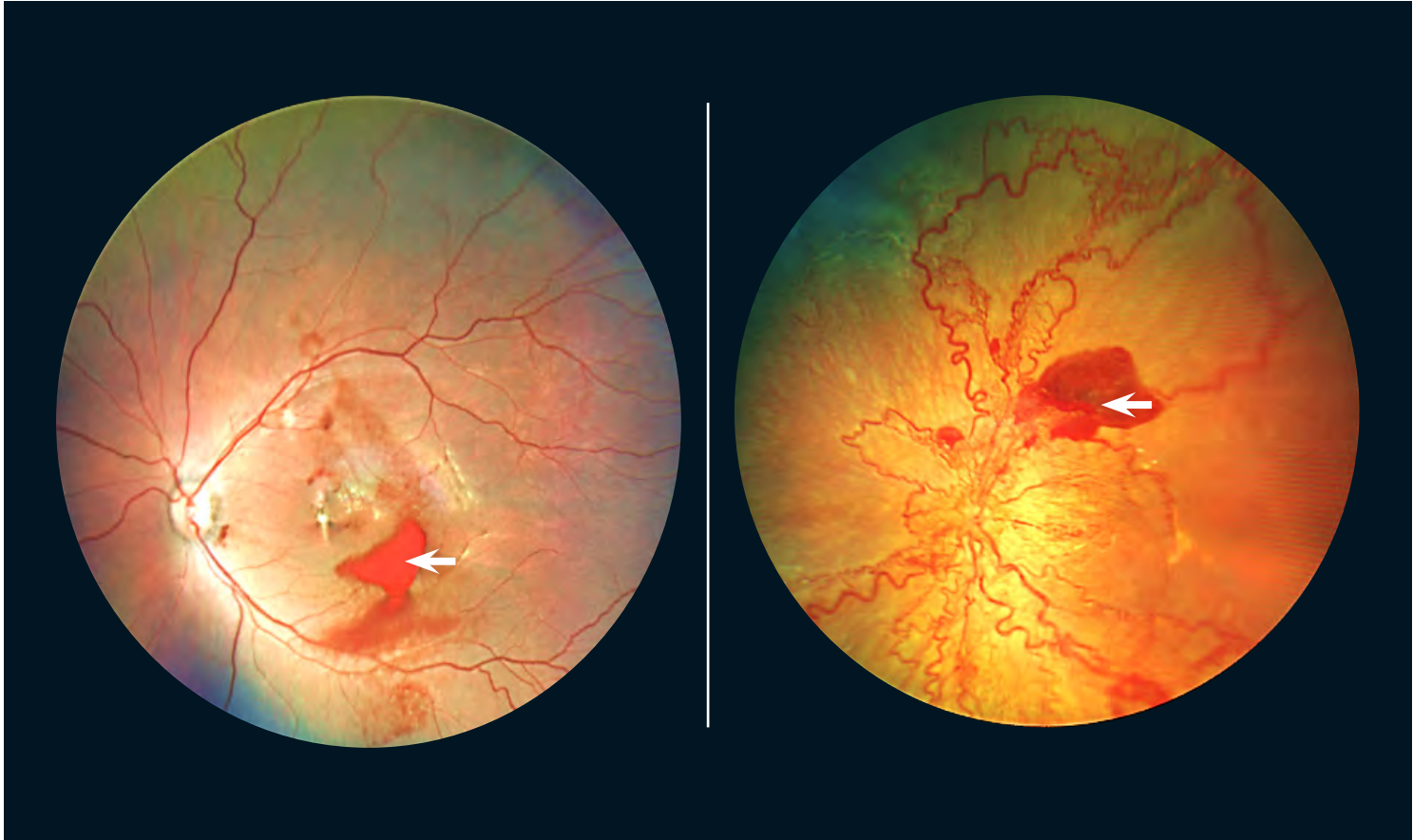




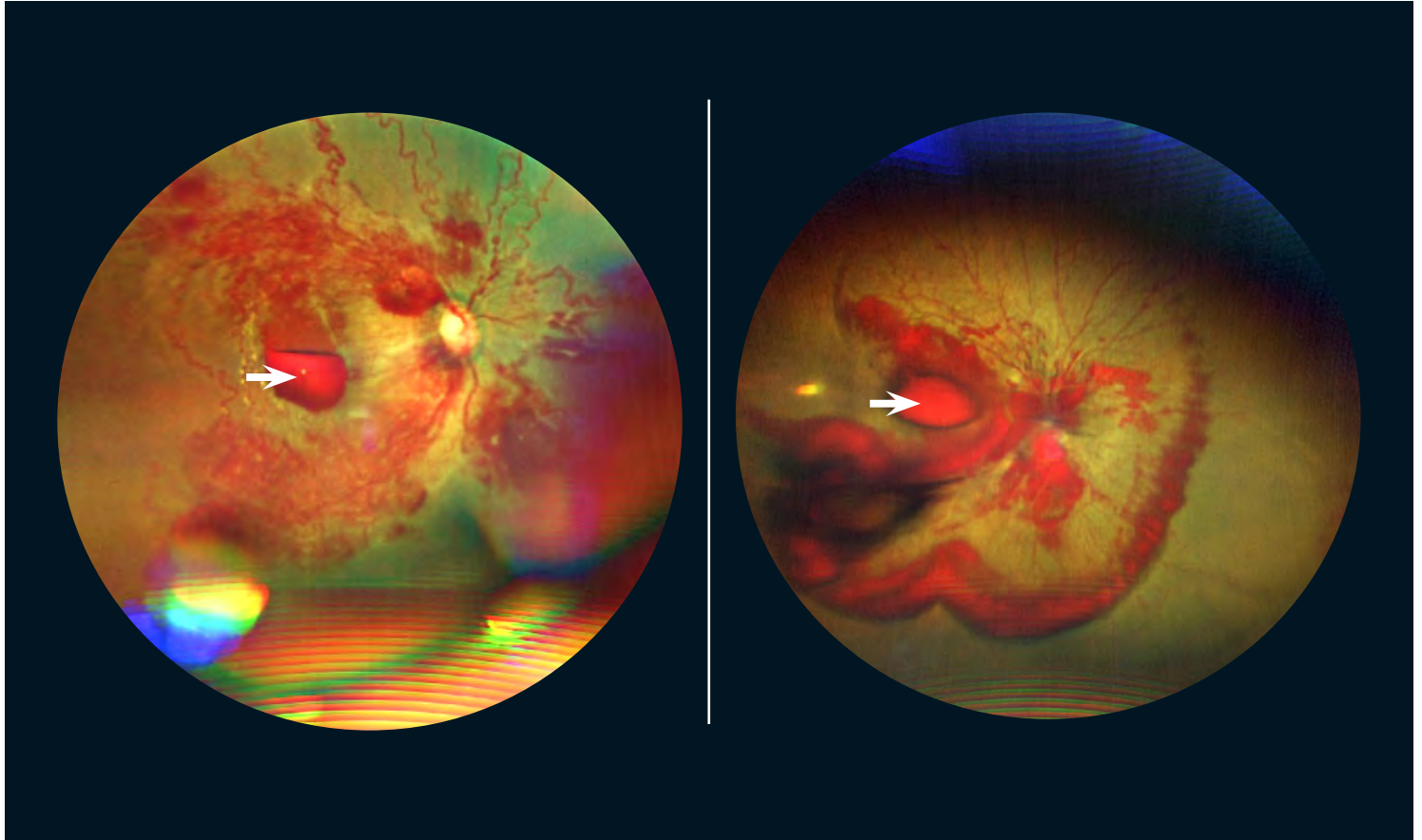
Neovascular fronds / tufts indicated by arrow



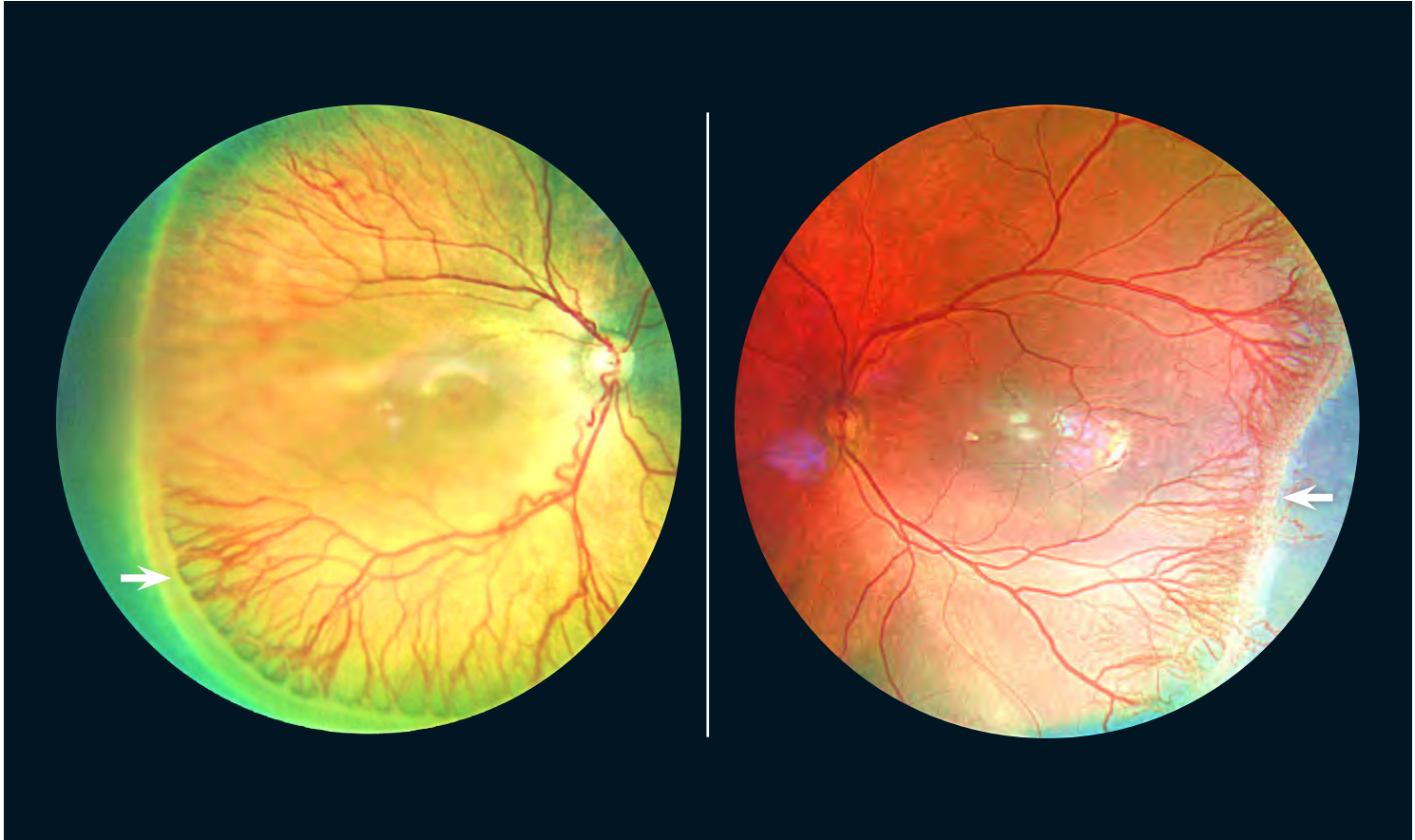
Preretinal hemorrhage indicated by arrow



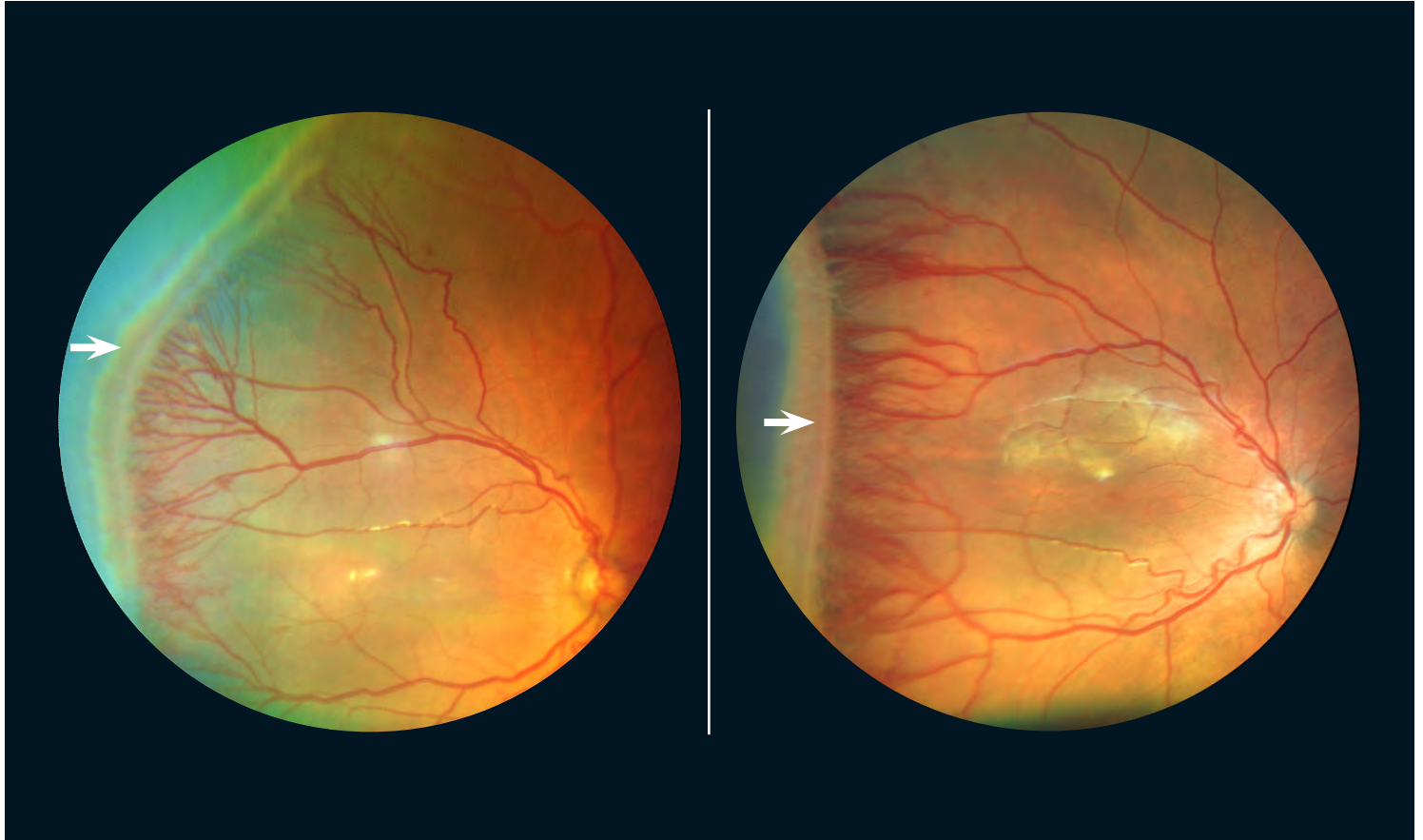
Sub hyaloid hemorrhage indicated by arrow



Ridge indicated by arrow



Ridge indicated by arrow





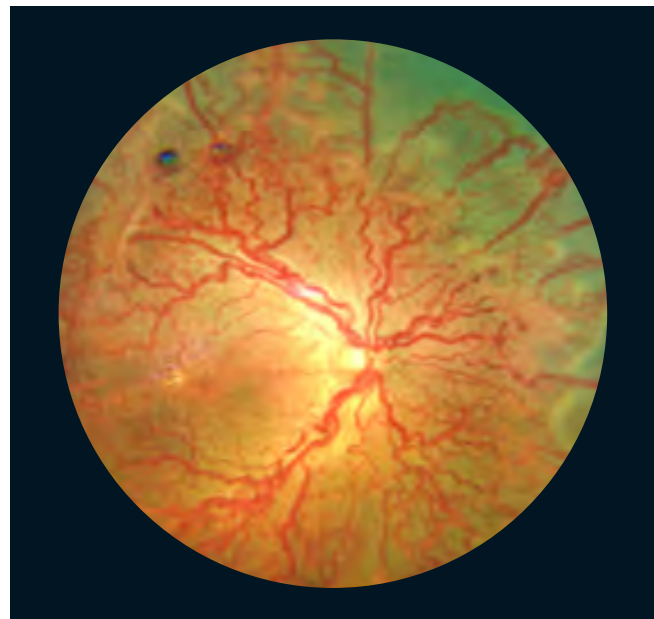
# Imaging Technique



## Widefield fundus imaging in newborn using the high resolution ZEISS CLARUS 700 true colour reflectance

All babies were examined with indirect ophthalmoscope after the instillation of topical mydriatic (tropicamide 1% and phenylephrine 2.5%) 3 times at an interval of 10 minutes and topical proparacaine 0.5% once before inserting a paediatric Alphonso lid speculum. Non-Contact Widefield Imaging (NC-WFI) was then performed using the ZEISS CLARUS 700 high resolution true colour reflectance imaging (Carl Zeiss Meditec, Dublin, CA) in the retina diagnostic set up at LV Prasad Eye Institute.

The babies were covered with warm clothing, they were fed and burped prior to the imaging procedure and were held in the modified 'flying baby position', with one arm supporting the chest/chin and the other hand supporting the head. The head was supported towards the machine, with visual feedback on the monitor guiding the pupillary alignment and the diagnostic technician captured the images. NC-WFI was performed using the ZEISS CLARUS 700 high resolution true colour reflectance imaging. All the babies were carefully monitored during the procedure and none of the babies developed apnoea, cyanosis, or feed intolerance during the procedure.



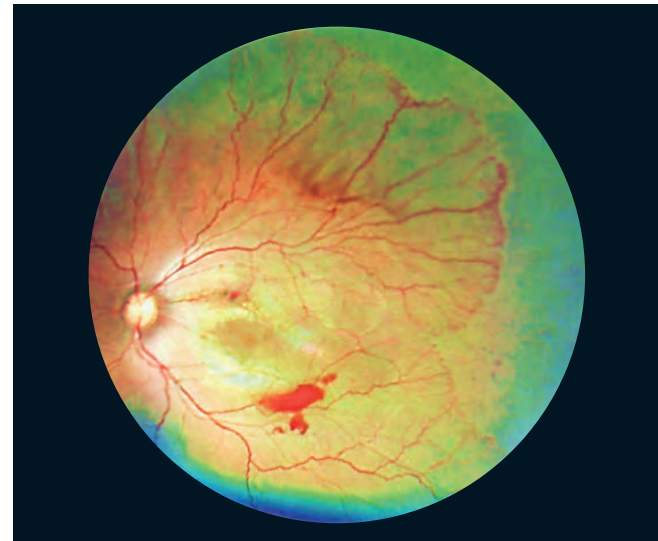


The minimum pupillary diameter to acquire the images was 2.5mm and the working distance (baby's eye to front of lens) was 25mm.

Using a monochromatic camera, a broad line of illumination scans across the retina. Red, green and blue Light Emitting Diodes (LEDs) sequentially illuminate to generate true colour reflectance images which is captured on the monitor. The image acquisition speed was fast (<0.2 seconds) and the screen resolution was 1920x1080



pixels. A single image measured from the centre of the eye gives a Field of View (FOV) of 133-degree wide and 133-degree high, two images stitched together gives ultra-widefield 200-degree wide in one of the dimensions and by 133-degree high in the other dimension of the FOV. Since the babies do not fixate on the fixation target, custom montage images (2-6 images) are constructed by ZEISS CLARUS 700 machine which takes a series of widefield images, and the technician can decide how many images to include in the montage.





# **Aggressive Posterior Retinopathy of Prematurity (APROP)**

## APROP

### CASE 1

#### History

A preterm baby with gestational age 28 weeks, birth weight 1200 grams and post menstrual age 32 weeks.

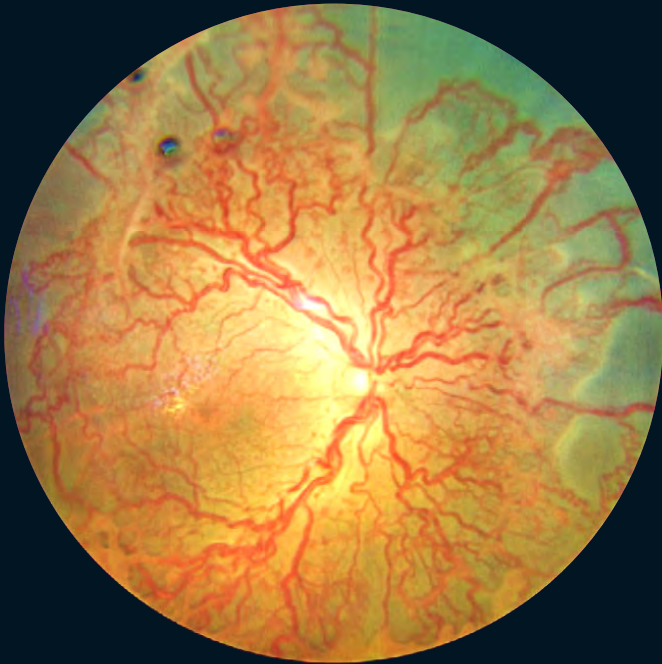
#### Description

Right eye - Aggressive Posterior Retinopathy of Prematurity (APROP) with vessels in Zone 1 showing extensive looping, shunting of vessels and areas of vitreous condensation and neovascularization.

Left eye - Aggressive Posterior Retinopathy of Prematurity (APROP) with looping and shunting of vessels which looks less severe than right eye with absence of vitreous condensation and neovascular tufts.

#### Management

Baby was advised intravitreal anti-VEGF (anti-Vascular Endothelial Growth Factor) injection in both the eyes on the same day. Post injection at 1-week follow-up reduced plus disease and decreased tortuosity of vessels. At 3-week follow-up the Anti-Vascular loops opened, and the vessels advanced to Zone 2.



## APROP

### CASE 2

#### History

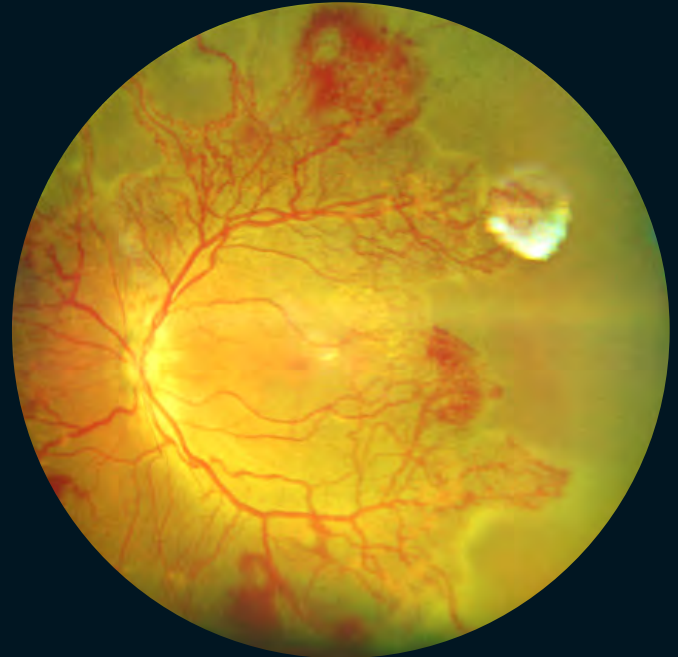
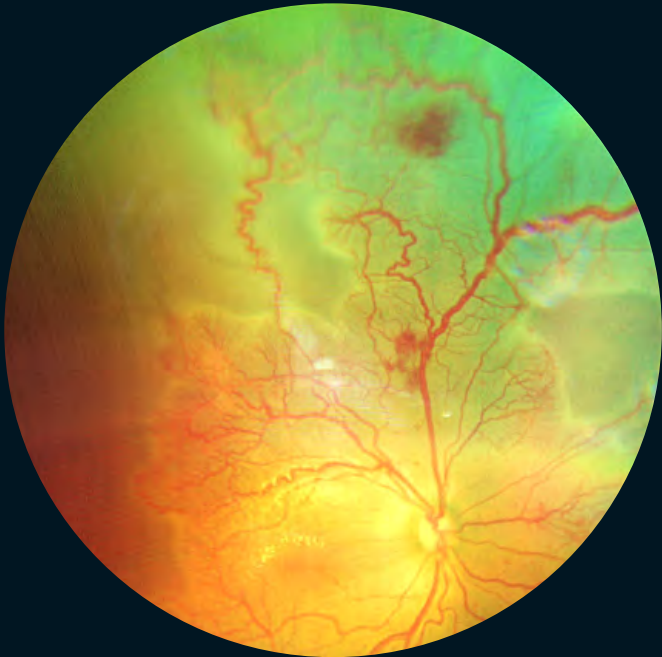
A preterm baby with gestational age 34 weeks, birth weight 1800 grams and post menstrual age 39 weeks.

#### Description

Both eyes Aggressive Posterior Retinopathy of Prematurity (APROP) with tortuous and dilated vessels in Zone 1 with extensive looping and shunting of vessels with areas of neovascularization, hemorrhages and ridge formation with avascular temporal retina. The left eye looks more severe with more areas of neovascularization and vitreous condensation.

#### Management

Baby was advised intravitreal anti-VEGF (anti-Vascular Endothelial Growth Factor) injection in both the eyes on the same day. Post injection follow up at 1-week showed reduced plus disease with decreasing tortuosity of vessels and reducing preretinal hemorrhages.



## APROP

### CASE 2: Continued follow up at 1-week

#### Description

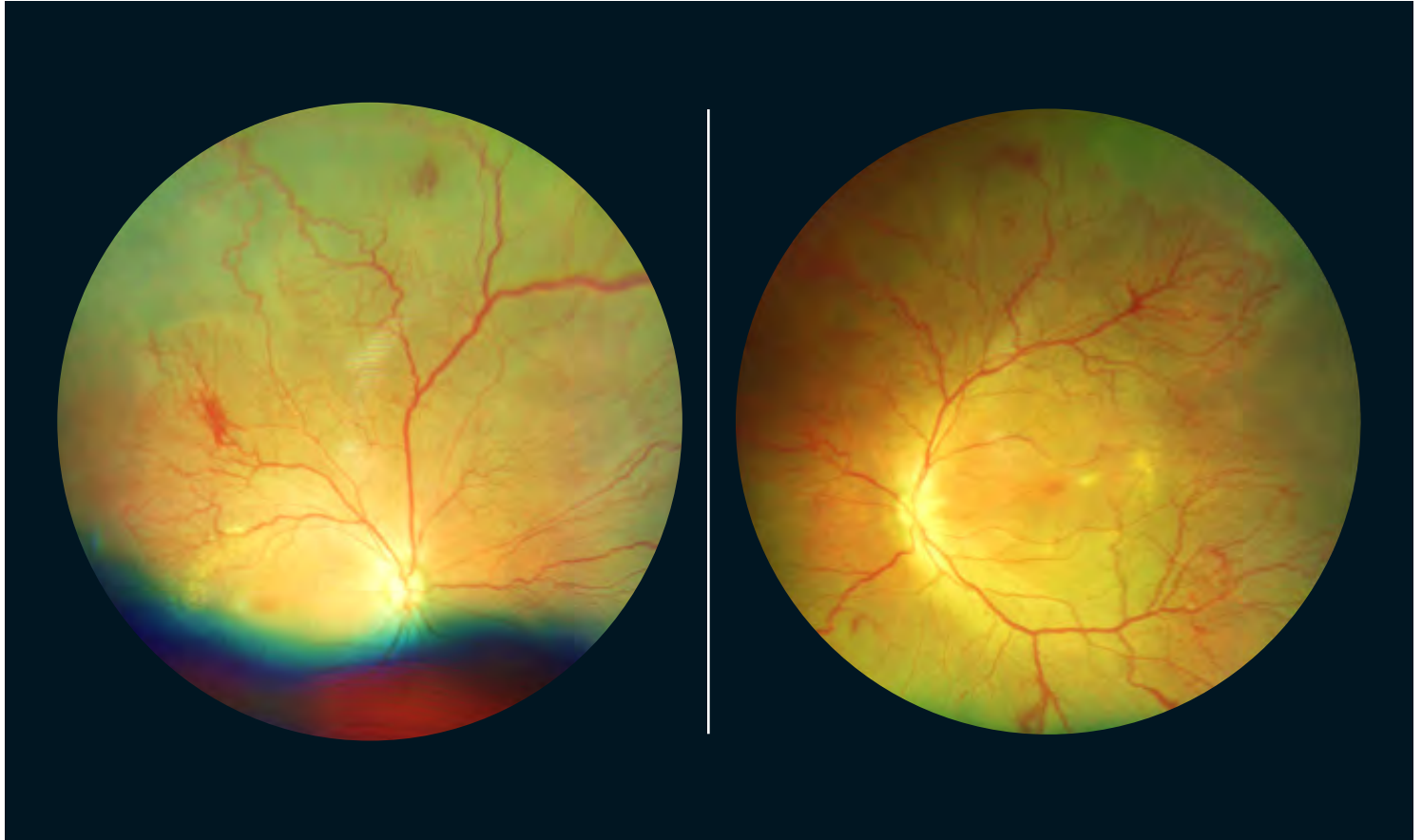
Post injection follow up at 1-week showed reduced plus disease with decreasing tortuosity of vessels and reducing preretinal hemorrhages. Right eye shows lower lid artifact.

#### Management

Observe

At 1-month follow-up the Anti-Vascular loops opened, the hemorrhages completely resolved, and the vessels advanced to Zone 2.





## APROP

### CASE 3

#### History

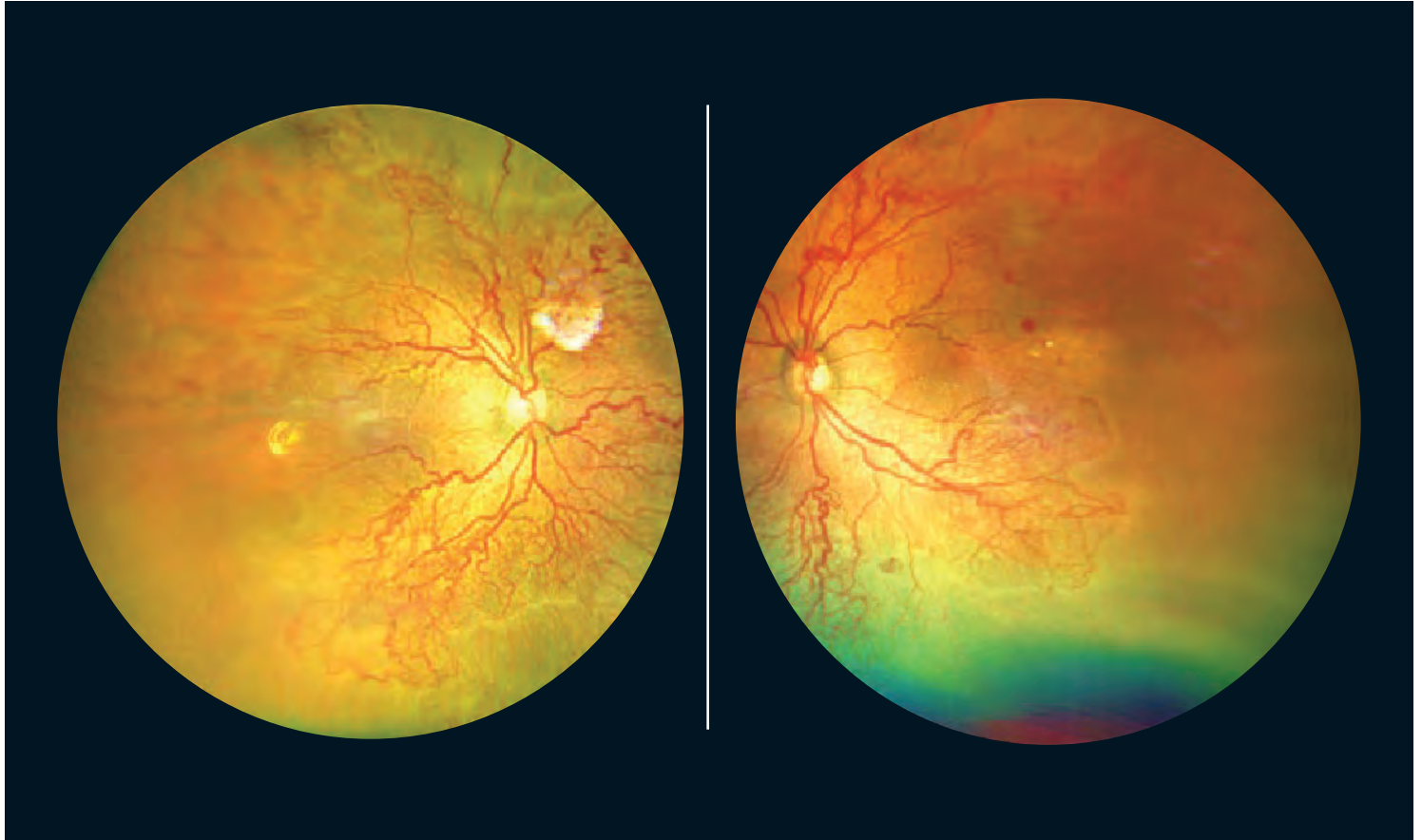
A preterm baby with gestational age 32 weeks, birth weight 1500 grams and post menstrual age 37 weeks.

#### Description

Both eyes Aggressive Posterior Retinopathy of Prematurity (APROP) with tortuous and dilated vessels in Zone 1 with extensive looping and shunting of vessels with areas of neovascularization. The macula is still not completely vascularized in both eyes and there is extensive avascular areas in both eyes. However, the severity of the disease is comparable in both the eyes.

#### Management

Baby was advised intravitreal anti-VEGF (anti-Vascular Endothelial Growth Factor) injection in both the eyes on the same day. Post injection follow up at 1-week showed reduced plus disease with decreasing tortuosity of vessels.



## APROP

### CASE 3: Continued follow up at 1-week

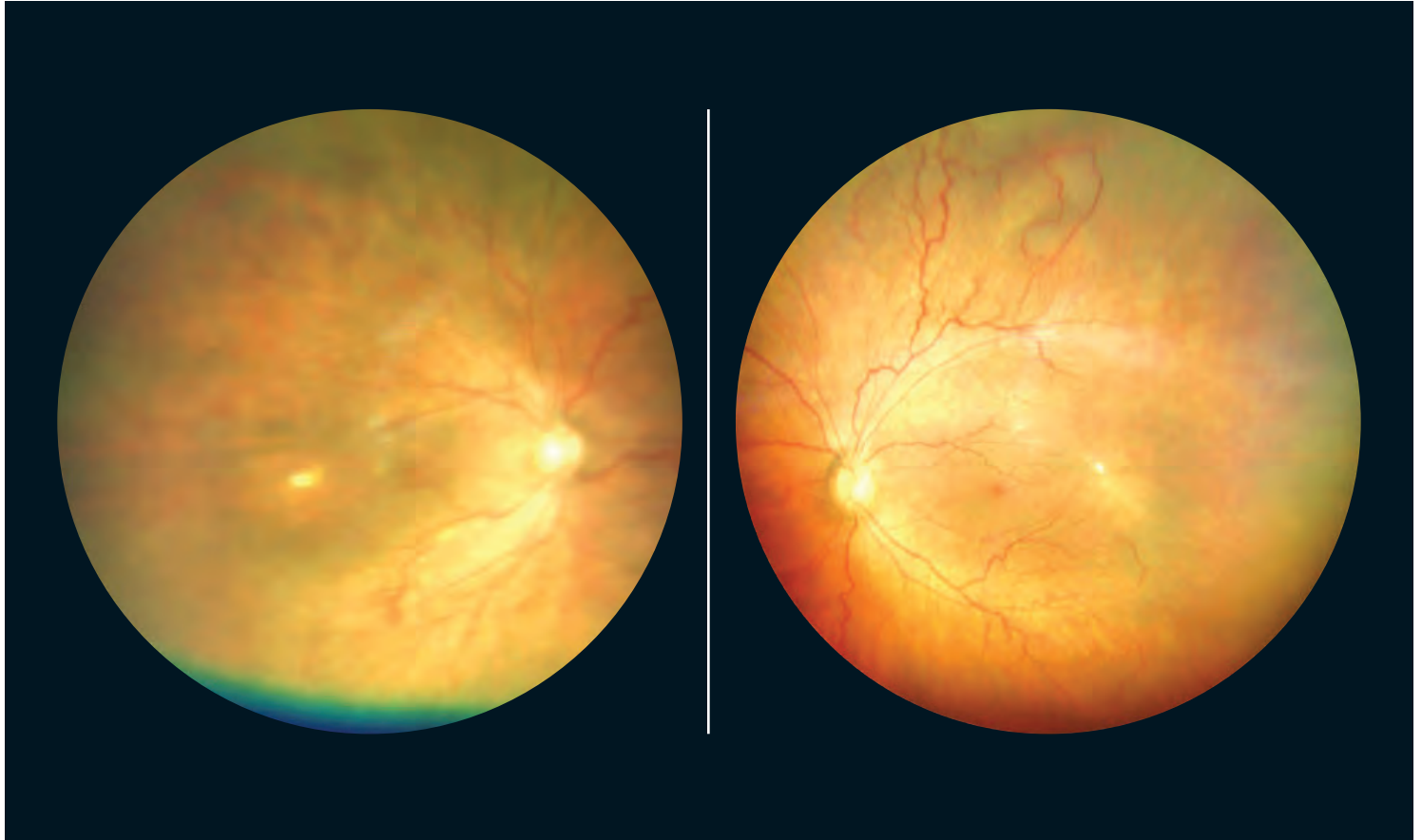
#### Description

Post injection follow up at 1-week showed reduced plus disease with decreasing tortuosity of vessels.

#### Management

Observe

At 1-month follow-up the vascular tortuosity and plus had significantly reduced but the vascular progression was still on a slower side with vessels just at Zone 2 posterior.



## APROP

### CASE 4

#### History

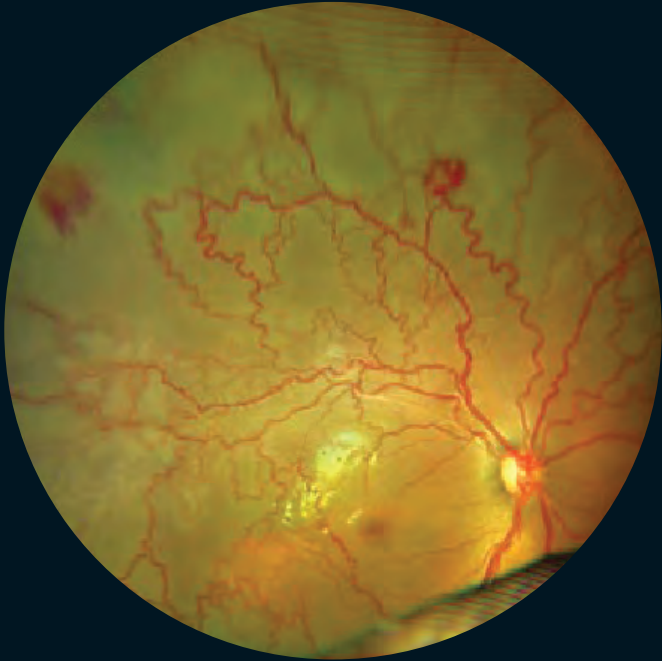
A preterm baby with gestational age 32 weeks, birth weight 1600 grams and post menstrual age 36 weeks.

#### Description

Both eyes Aggressive Posterior Retinopathy of Prematurity (APROP) with tortuous and dilated vessels in Zone 1 with extensive looping, shunting of vessels and areas of neovascularization. Right eye in addition has few hemorrhages at the superior arcade with extensive avascular retina seen in the superior half. Right eye shows inferior lid artifact.

#### Management

Baby was advised intravitreal anti-VEGF (anti-Vascular Endothelial Growth Factor) injection in both the eyes on the same day. Post injection follow up at 1-week showed reduced plus disease with decreasing tortuosity of vessels. At 3-week follow-up the vascular loops had opened, and the vessels were advancing to Zone 2.



## APROP

### CASE 5

#### History

A preterm baby with gestational age 28 weeks, birth weight 1400 grams and post menstrual age 34 weeks.

#### Description

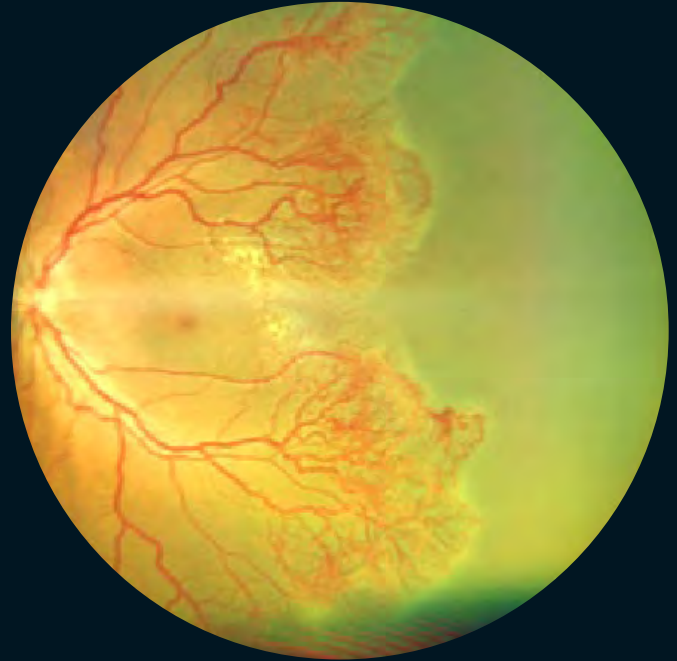
Both eyes Hybrid plus Retinopathy of Prematurity (ROP) with tortuous and dilated vessels at the border of Zone 1 and Zone 2 posterior with areas of ridge and temporal tufts of neovascularization fronds.

Left eye in addition shows temporal extensive avascular retina.

#### Management

Baby was advised intravitreal anti-VEGF (anti-Vascular Endothelial Growth Factor) injection in both the eyes on the same day. Post injection follow up at 1-week showed reduced plus disease, decreasing tortuosity of vessels and reducing neovascular fronds.





## APROP

### CASE 5: Continued follow up at 1-week

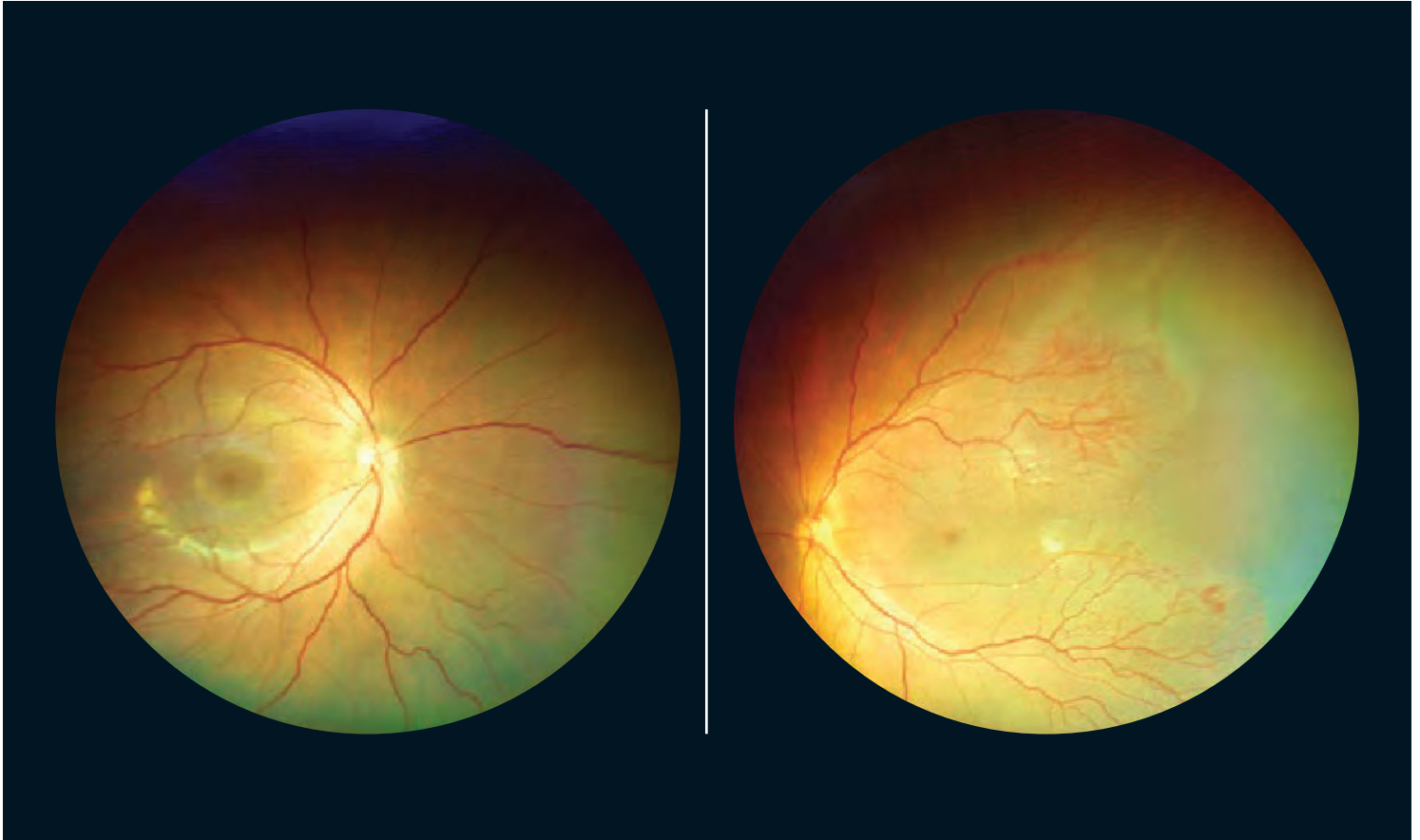
#### Description

Post injection follow up at 1-week showed reduced plus disease, decreasing tortuosity of vessels and reducing neovascular fronds.

#### Management

Observe

At 1-month follow-up the plus disease and tortuosity of vessels had significantly reduced, and the vessels were progressing to Zone 2 anterior.



## APROP

### CASE 6

#### History

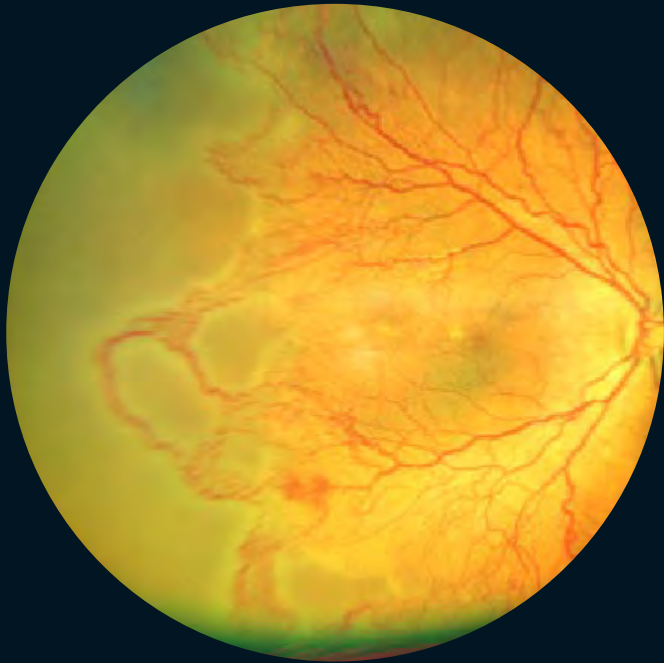
A preterm baby with gestational age 28 weeks, birth weight 1400 grams and post menstrual age 35 weeks.

#### Description

Both eyes Aggressive Posterior Retinopathy of Prematurity (APROP) with tortuous and dilated vessels in Zone 1 with extensive looping, shunting of vessels and areas of neovascularization. Right eye shows temporal extensive avascular retina. However, the left eye disease looks more severe than right eye. Left eye also shows inferior lid artifact.

#### Management

Baby was advised intravitreal anti-VEGF (anti-Vascular Endothelial Growth Factor) injection in both the eyes on the same day. Post injection follow up at 1-week showed reduced plus disease, decreasing tortuosity of vessels and reducing neovascular fronds.



## APROP

### CASE 6: Continued follow up at 1week

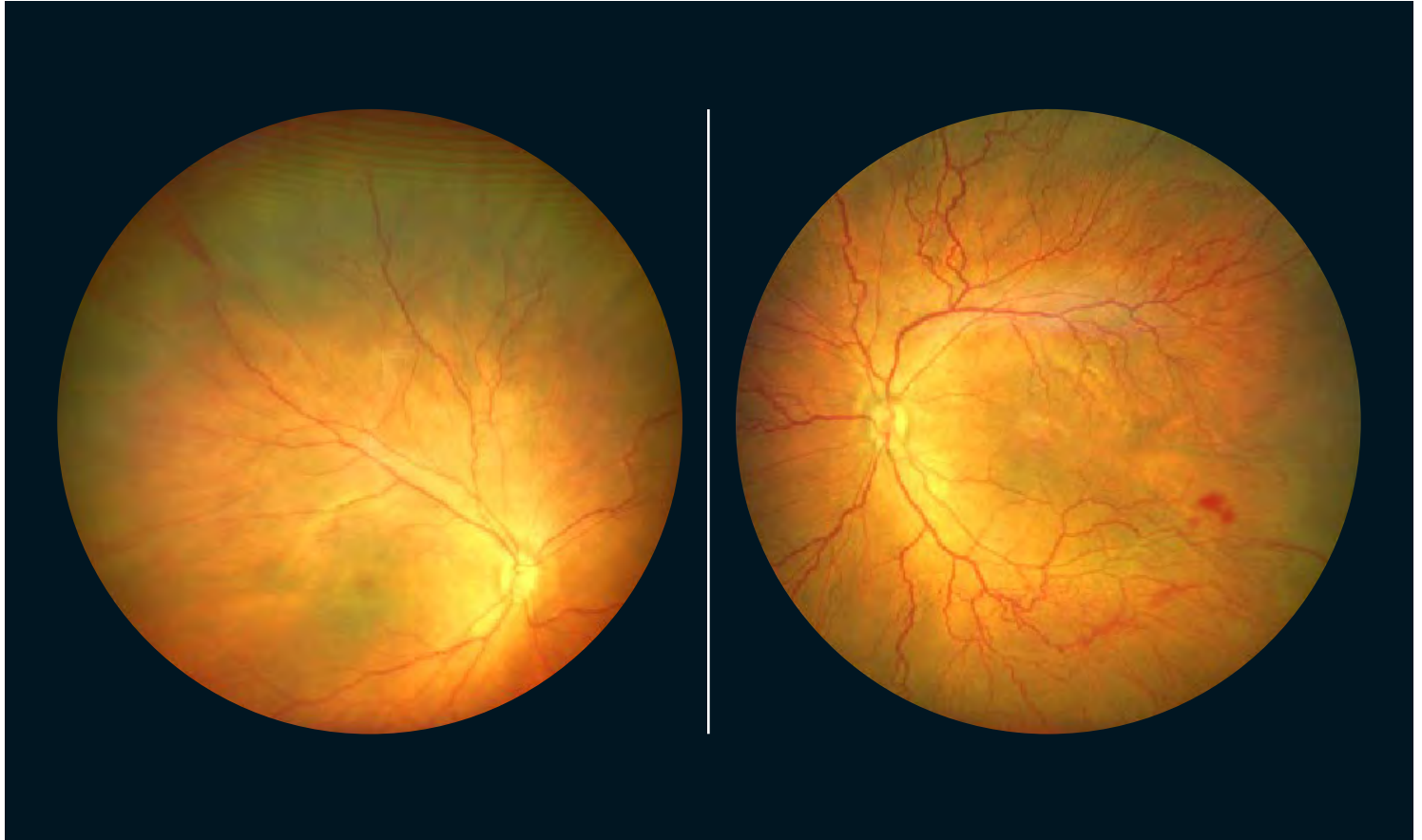
#### Description

Post injection follow up at 1-week showed reduced plus disease, decreasing tortuosity of vessels and reducing neovascular fronds.

#### Management

Observe

At 1-month follow up the vessels were progressing to Zone 2 anterior in the right eye and Zone 2 posterior in the left eye. The right eye response to anti-VEGF was better than left eye at 1-month.



## APROP

### CASE 7

#### History

A preterm baby with gestational age 34 weeks, birth weight 1900 grams and post menstrual age 39 weeks.

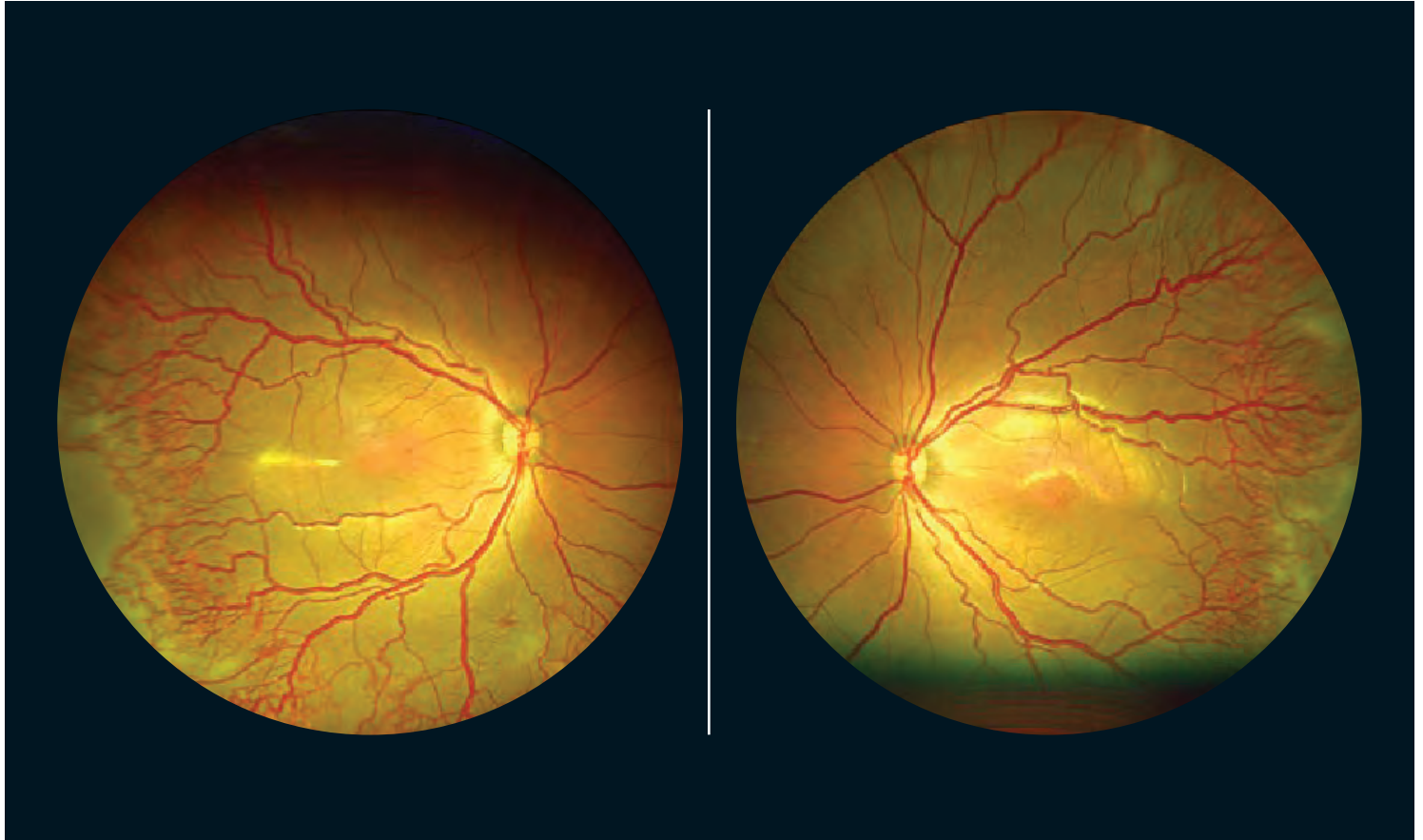
#### Description

Both eyes Zone 2 posterior Stage 3 Hybrid plus Retinopathy of Prematurity (ROP) with dilated and tortuous vessels with extensive fronds of neovascular tufts temporally. Disease severity looks comparable in both the eyes. Left eye lower lid artifact is seen.

#### Management

Baby was advised intravitreal anti-VEGF (anti-Vascular Endothelial Growth Factor) injection in both the eyes on the same day. Post injection follow up at 1-week showed reduced plus disease, decreasing tortuosity of vessels and reducing neovascular fronds.





## APROP

### CASE 7: Continued follow up at 1-week

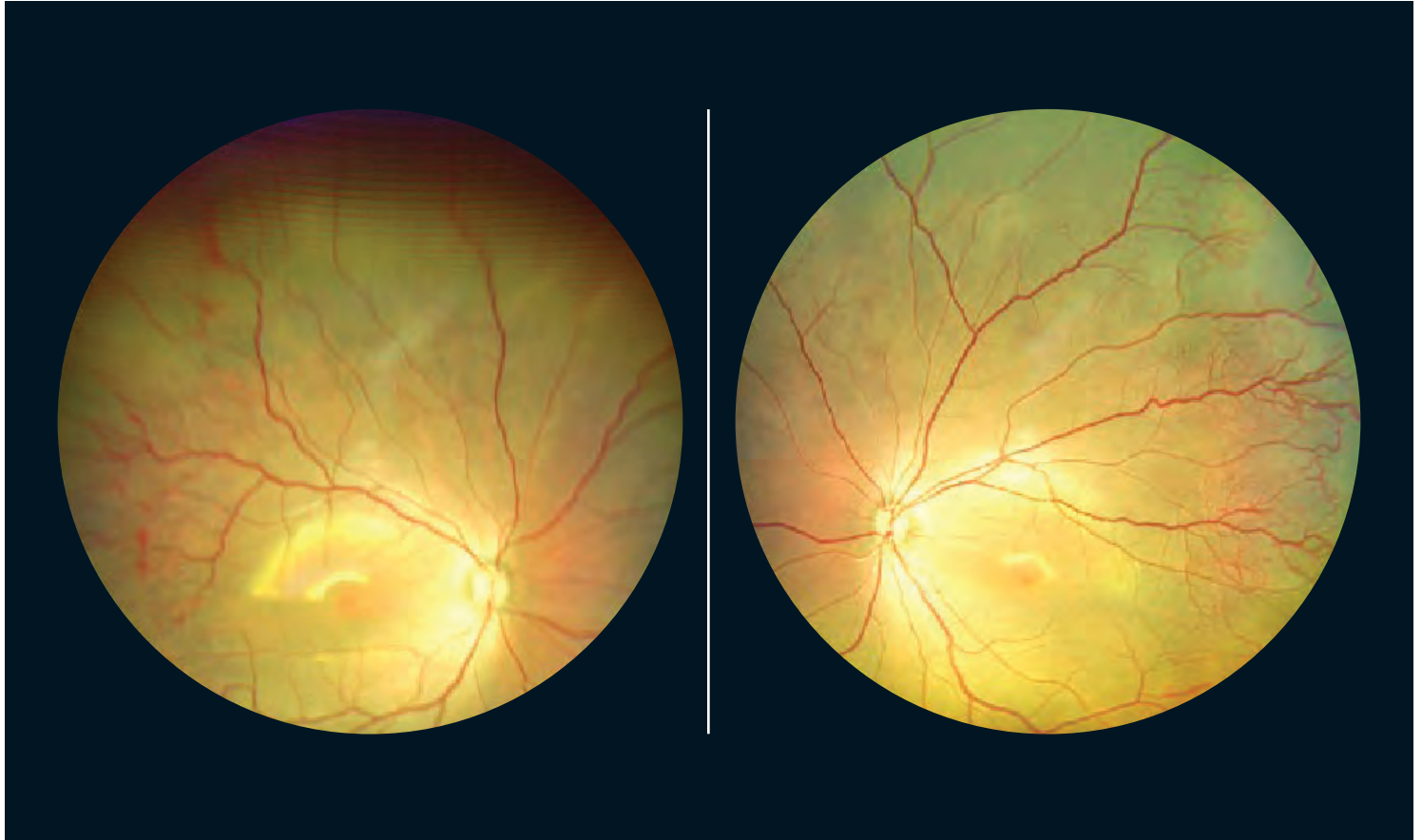
#### Description

Post injection follow up at 1-week showed reduced plus disease, decreasing tortuosity of vessels and reducing neovascular fronds.

#### Management

Observe

At 1-month follow-up the vessels were progressing to Zone 2 anterior.



## APROP

### CASE 8

#### History

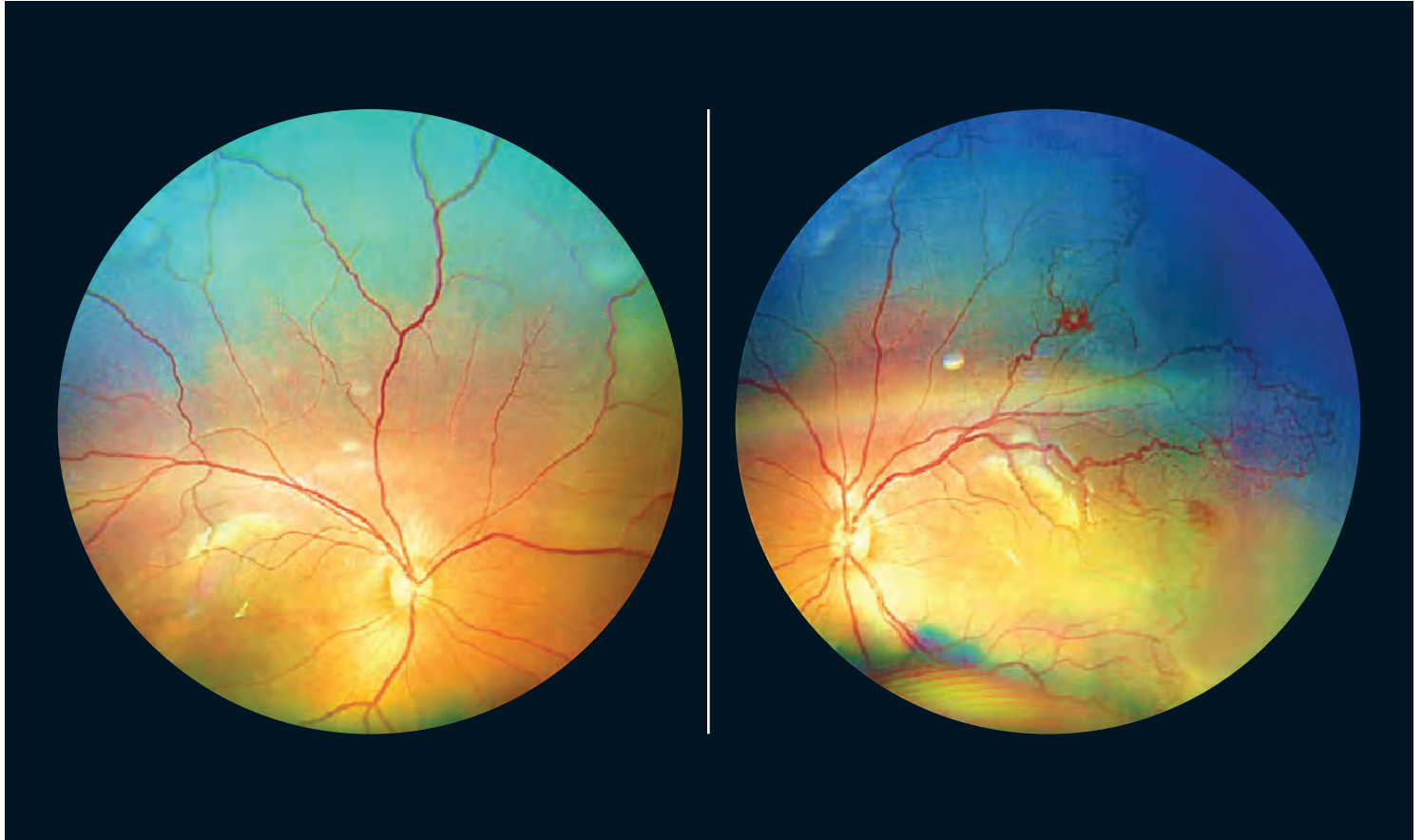
A preterm baby with gestational age 34 weeks, birth weight 1700 grams and post menstrual age 40 weeks.

#### Description

Both eyes Zone 2 posterior Stage 3 plus Hybrid Retinopathy of Prematurity (ROP). Left eye looks more severe than right eye with looping and shunting of vessels temporally with few hemorrhages.

#### Management

Baby was advised intravitreal anti-VEGF (anti-Vascular Endothelial Growth Factor) injection in both the eyes on the same day. Post injection follow up at 1-week showed reduced plus disease, decreasing tortuosity of vessels and loops had opened, allowing the vessels to reach Zone 2 in both eyes. At 1-month follow-up the vessels had rapidly reached Zone 3.



## APROP

### CASE 9

#### History

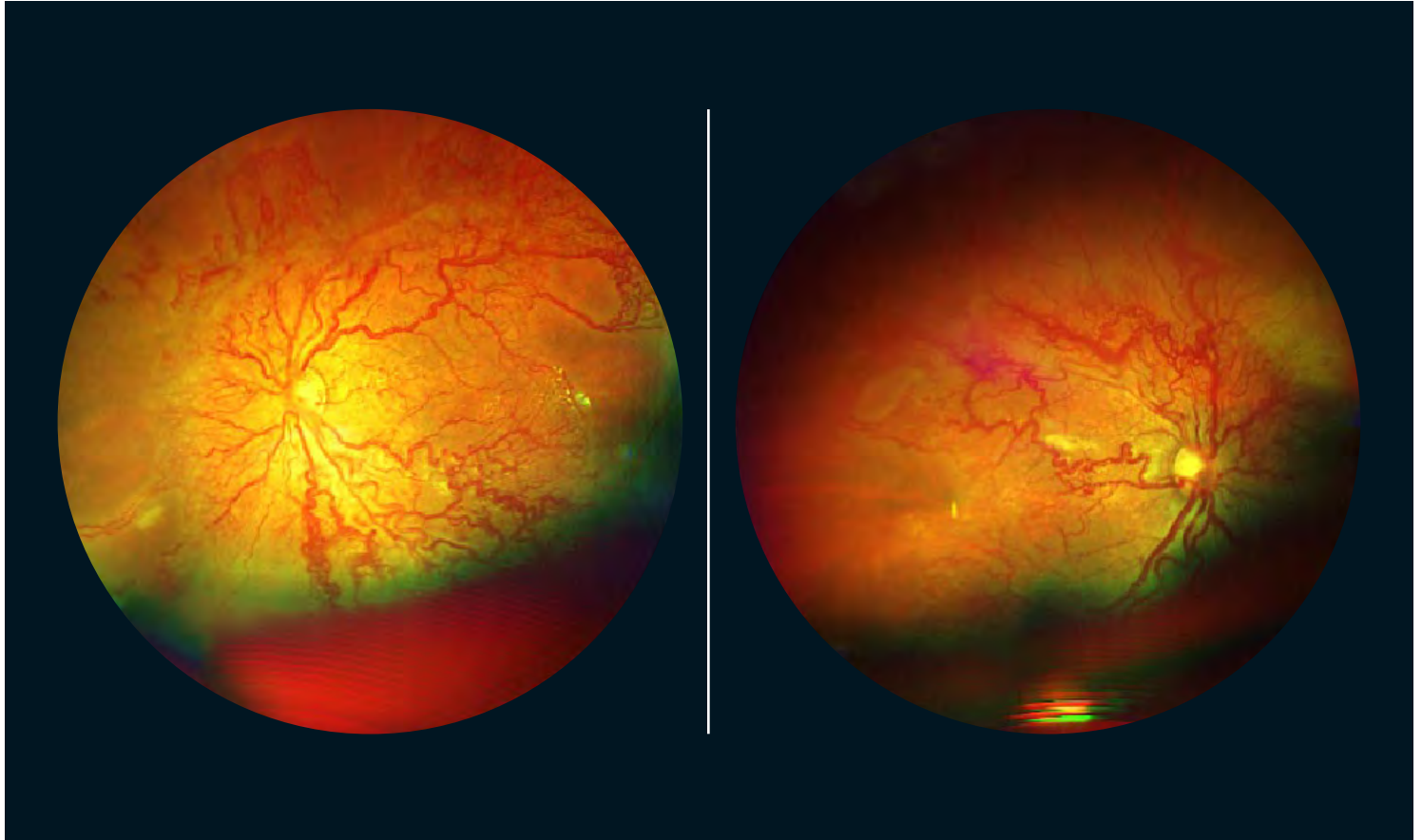
A preterm baby with gestational age 30 weeks, birth weight 1700 grams and post menstrual age 35 weeks.

#### Description

Both eyes show angry looking Zone 1 Stage 3 Aggressive Posterior Retinopathy of Prematurity (APROP) with severe plus with shunting and looping of vessels. The macula is just vascularized in the right eye, and yet to be completely vascularized in the left eye. Both eyes show inferior lower eyelid artifact.

#### Management

Baby was advised intravitreal anti-VEGF (anti-Vascular Endothelial Growth Factor) injection in both the eyes on the same day. Post injection follow up at 1-week showed reduced plus disease with decreasing tortuosity of vessels. At 1-month follow-up the vascular tortuosity and plus had significantly reduced but the vascular progression was still on a slower side with vessels just at Zone 2 posterior.



## APROP

### CASE 10

#### History

A preterm baby with gestational age 32 weeks, birth weight 1600 grams and post menstrual age 36 weeks.

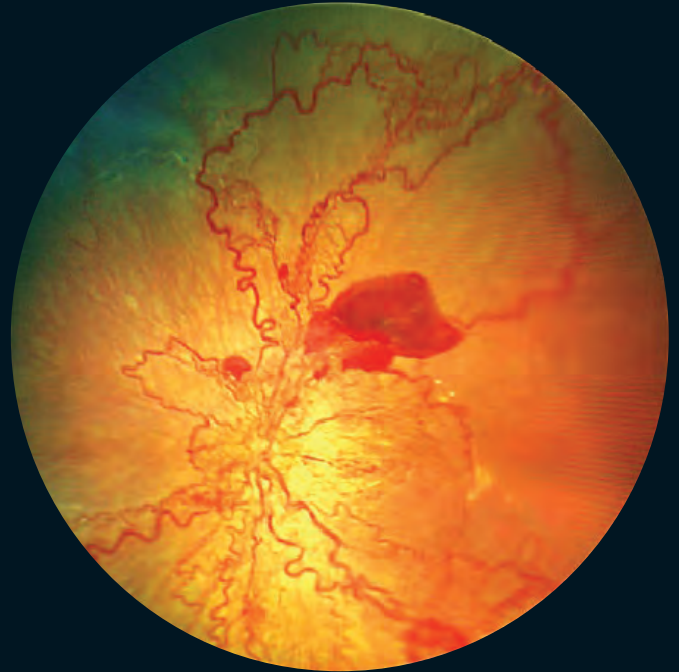
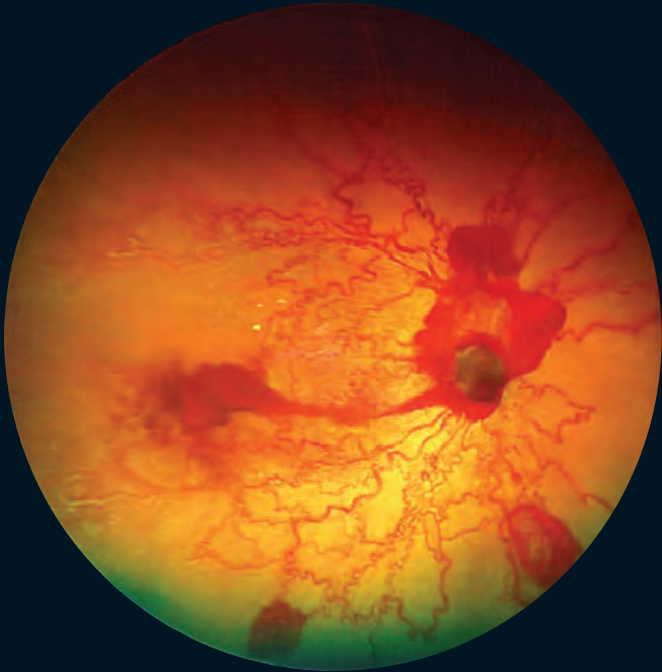
#### Description

Both eyes show a very angry looking Aggressive posterior ROP with significant looping and shunting of vessels with preretinal hemorrhages and plastered fibrin. The macula in both eyes is not yet completely vascularized.

#### Management

Baby was advised intravitreal anti-VEGF (anti-Vascular Endothelial Growth Factor) injection in both the eyes on the same day. Both eyes 1-week status post anti-VEGF injection showing reduced plus and tortuosity of vessels. But the preretinal hemorrhages are persisting in both the eyes.





## APROP

### CASE 10: Continued follow up at 1-week

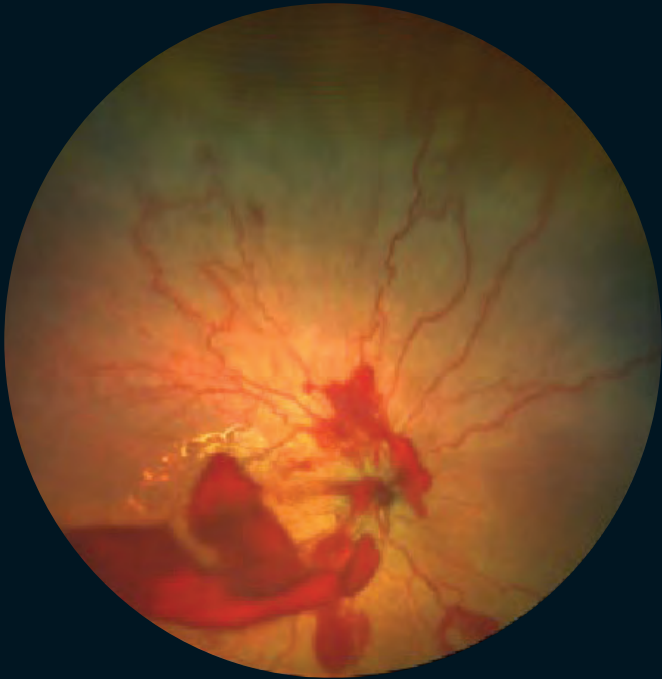
#### Description

Both eyes 1-week status post anti-VEGF injection showing reduced plus and tortuosity of vessels. But the preretinal hemorrhages are persisting in both the eyes.

#### Management

Observe

At 3 weeks post anti-VEGF follow up the plus disease had significantly reduced, loops had opened, allowing the vessels to reach Zone 2. However few areas of preretinal hemorrhage were persisting more so in the right eye.



## APROP

### CASE 11

#### History

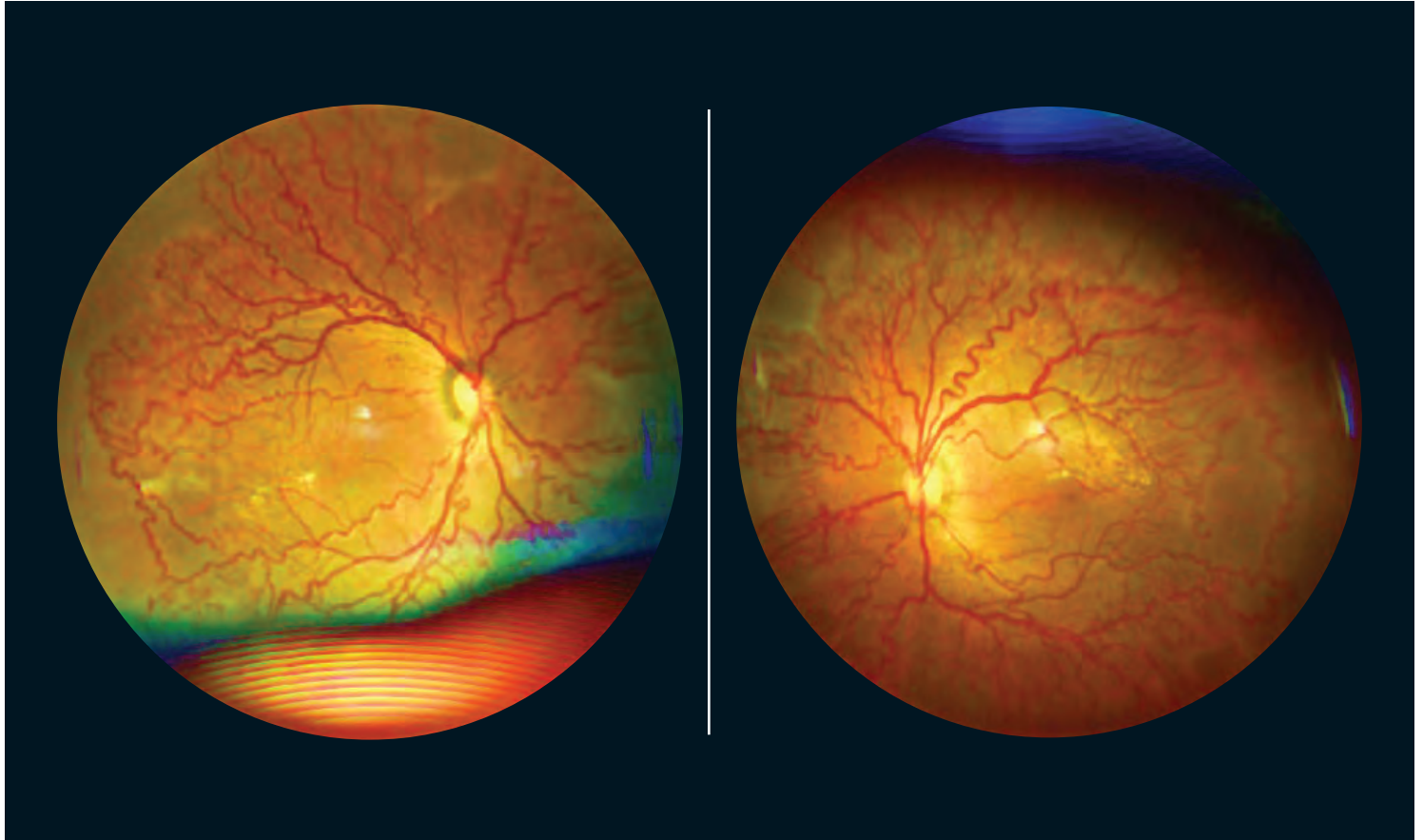
A preterm baby with gestational age 30 weeks, birth weight 1400 grams and post menstrual age 34 weeks.

#### Description

Both eyes Aggressive Posterior Retinopathy of Prematurity (APROP) with severe looping and shunting of vessels. The macula is just vascularized in both the eyes. Inferior lid artifacts is seen in right eye.

#### Management

Baby was advised intravitreal anti-VEGF (anti-Vascular Endothelial Growth Factor) injection in both the eyes on the same day. Post injection follow up at 1-week showed reduced plus disease with decreasing tortuosity of vessels. At 3-week follow-up the vascular loops had opened, and the vessels were advancing to Zone 2.



## APROP

### CASE 12: Right eye

#### History

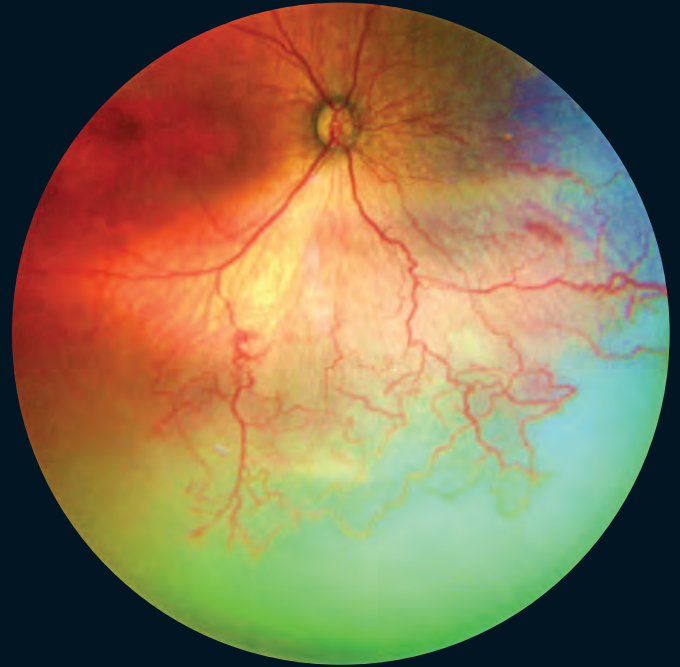
A preterm baby with gestational age 32 weeks, birth weight 1500 grams and post menstrual age 39 weeks.

#### Description

Right eye Aggressive Posterior Retinopathy of Prematurity (APROP) with severe looping and shunting of vessels. The macula is just vascularized. Inferior retina shows extensive avascular areas.

#### Management

Baby was advised intravitreal anti-VEGF (anti-Vascular Endothelial Growth Factor) injection on the same day. Post injection follow up at 1-week showed reduced plus disease with decreasing tortuosity of vessels. At 3-week follow-up the vascular loops opened, and the vessels advanced to Zone 2.



## APROP

### CASE 12: Left eye

#### History

A preterm baby with gestational age 32 weeks, birth weight 1500 grams and post menstrual age 39 weeks.

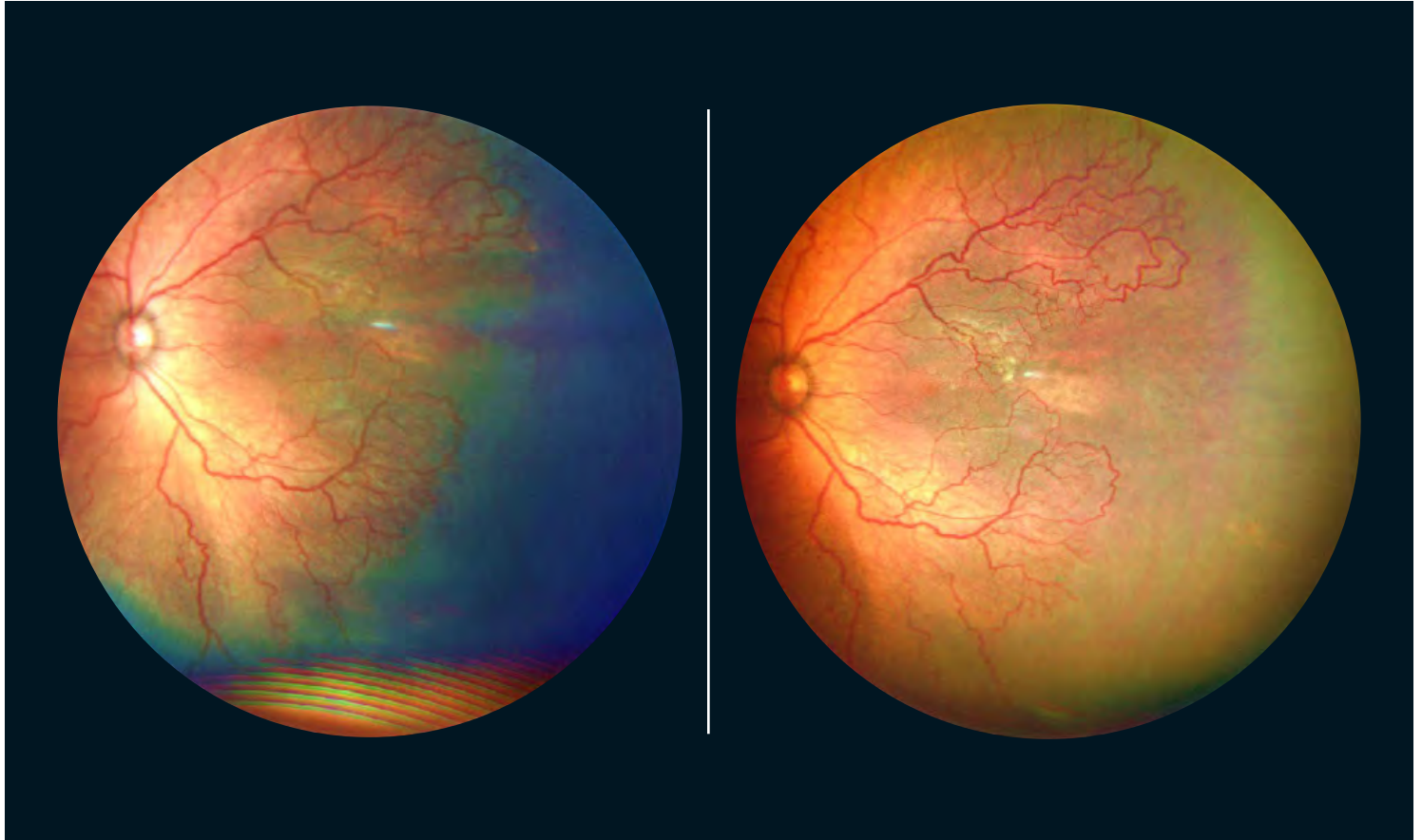
#### Description

Left eye Aggressive Posterior Retinopathy of Prematurity (APROP) with severe looping and shunting of vessels. The macula is just vascularized. Temporal retina shows extensive avascular areas.

#### Management

Baby was advised intravitreal anti-VEGF (anti-Vascular Endothelial Growth Factor) injection on the same day. Post injection follow up at 1-week showed reduced plus disease with decreasing tortuosity of vessels. At 3-week follow-up the vascular loops opened, and the vessels advanced to Zone 2.





## APROP

### CASE 13: Right eye

#### History

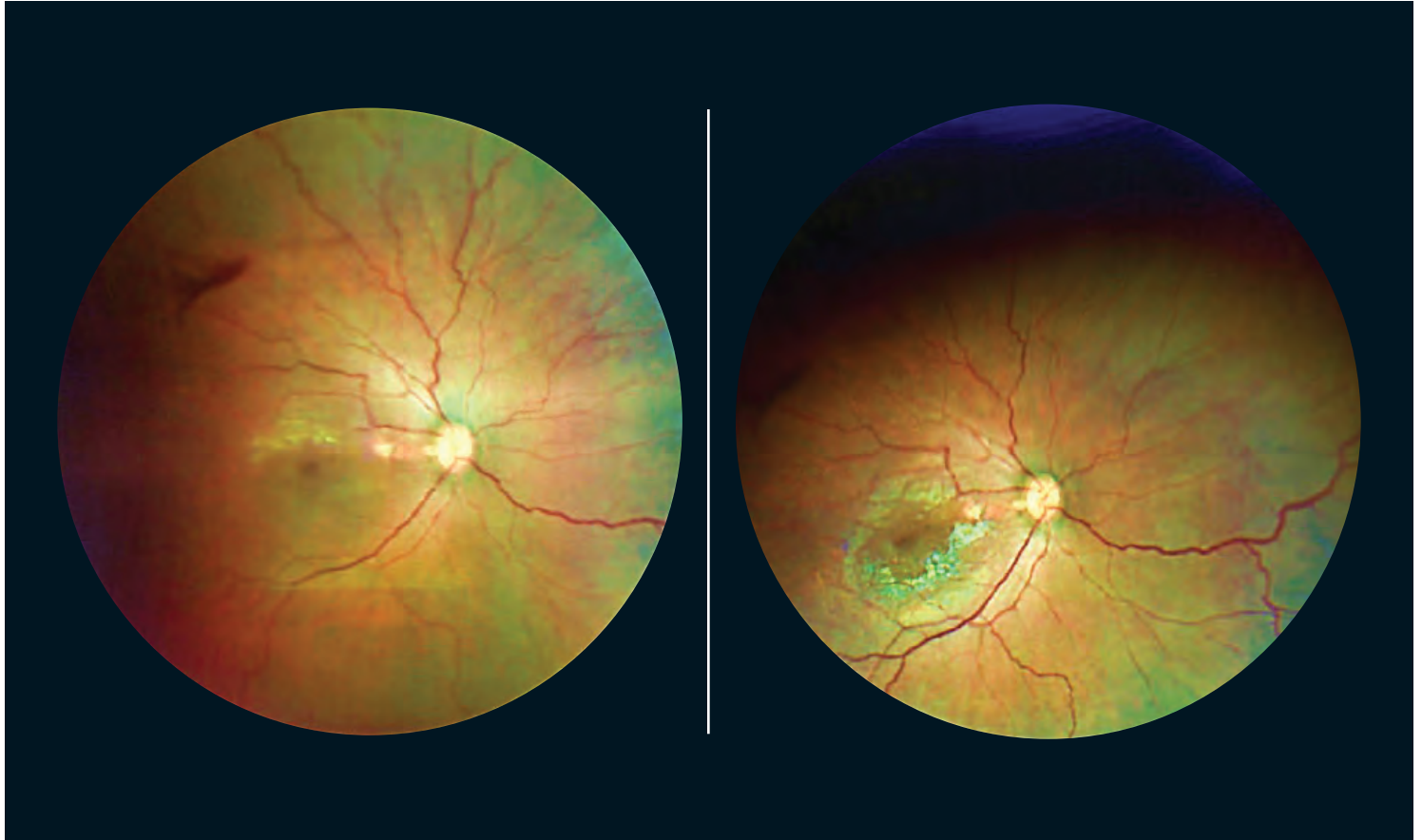
A preterm baby with gestational age 33 weeks, birth weight 1500 grams and post menstrual age 39 weeks.

#### Description

Right eye Aggressive Retinopathy of Prematurity (AROP) status post anti-VEGF injection given 1 week ago shows reduced plus in right eye. Right eye also shows hyperpigmentation temporal to disc.

#### Management

Right eye had received anti-VEGF injection 1-week prior. Post injection right eye showed favourable response at 1-week with reduced plus, decreasing hemorrhages and vessels going to Zone 2.



## APROP

### CASE 14

#### History

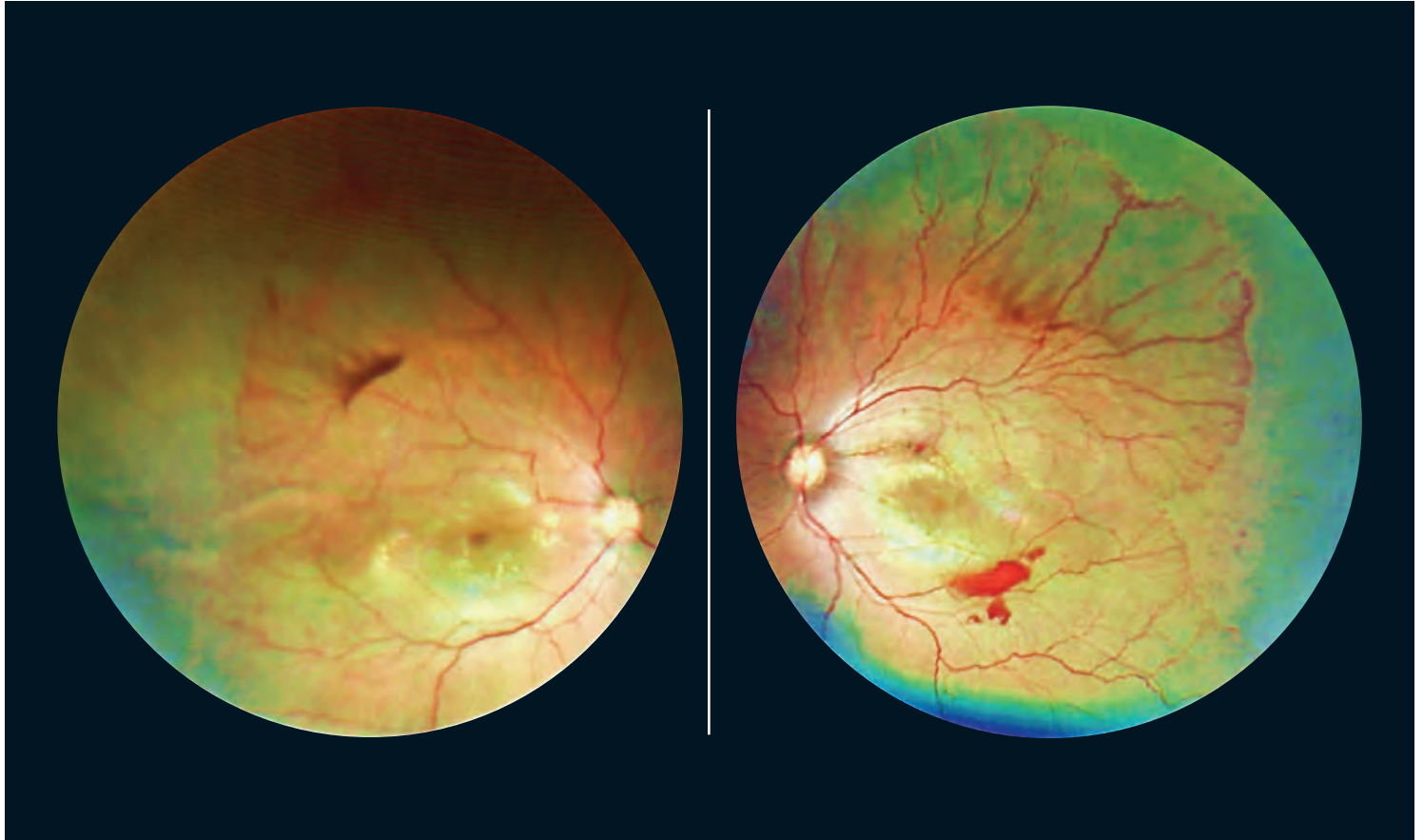
A preterm baby with gestational age 33 weeks, birth weight 1500 grams and post menstrual age 39 weeks.

#### Description

Both eyes Aggressive Retinopathy of Prematurity (ROP) status post anti-VEGF injection given 1 week ago shows reduced plus disease, but left eye shows persisting looping and preretinal hemorrhage.

#### Management

Both eyes status post anti-VEGF injection given 1-week back shows reduced plus but left eye shows persisting looping and preretinal hemorrhage. At 3 weeks follow-up the loops had opened in both eyes allowing the vessels to reach Zone 2 anterior.



## APROP

### CASE 15

#### History

A preterm baby with gestational age 29 weeks, birth weight 900 grams and post menstrual age 33 weeks.

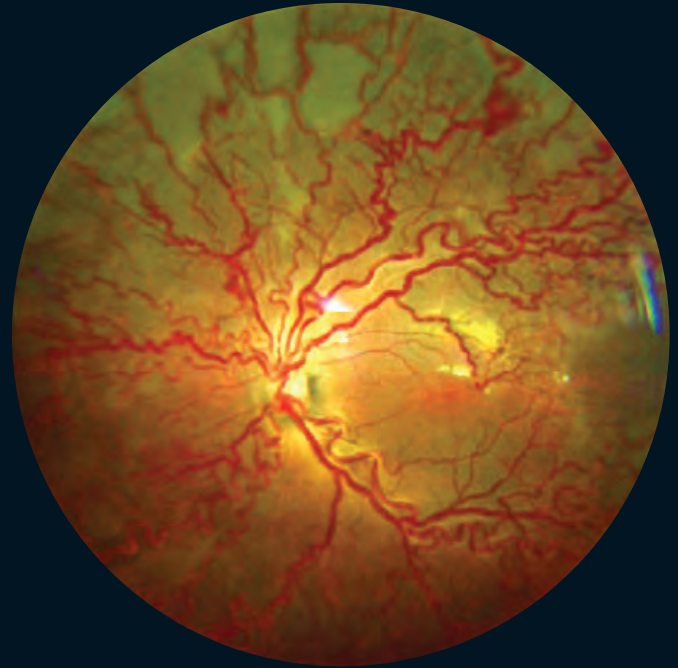
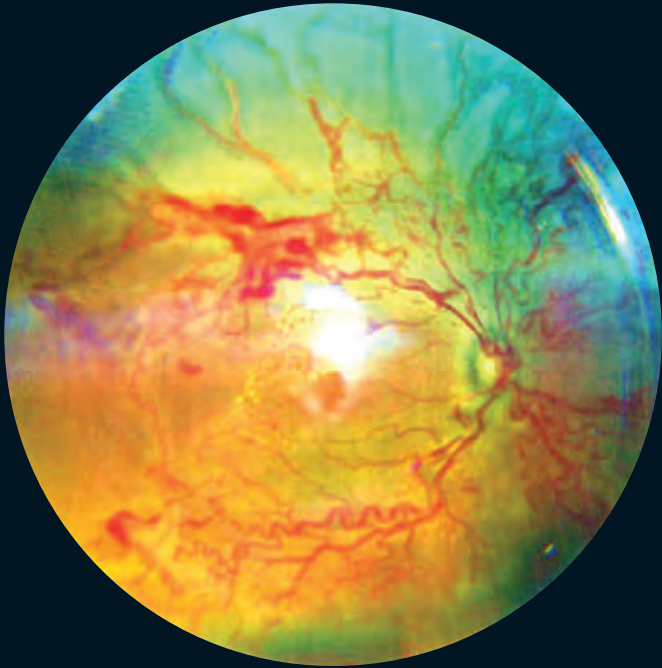
#### Description

Both eyes Aggressive Posterior Retinopathy of Prematurity (APROP) with looping and shunting of vessels and preretinal hemorrhage. Both eyes show plastered fibrin along supero-temporal arcade arcades.

The right eye, in addition, also had sclerosed vessels superiorly.

#### Management

Baby was advised intravitreal anti-VEGF (anti-Vascular Endothelial Growth Factor) injection in both the eyes on the same day.



## APROP

### CASE 15: Continued follow up at 1-week

#### Description

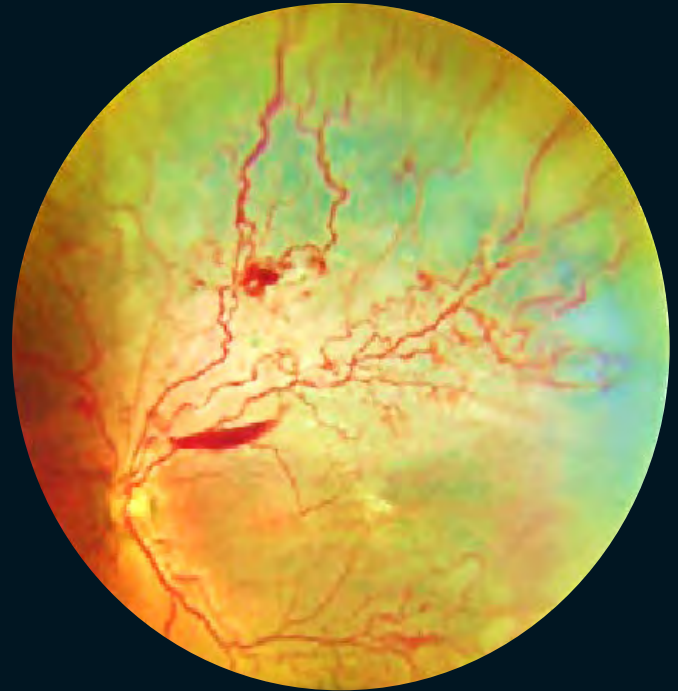
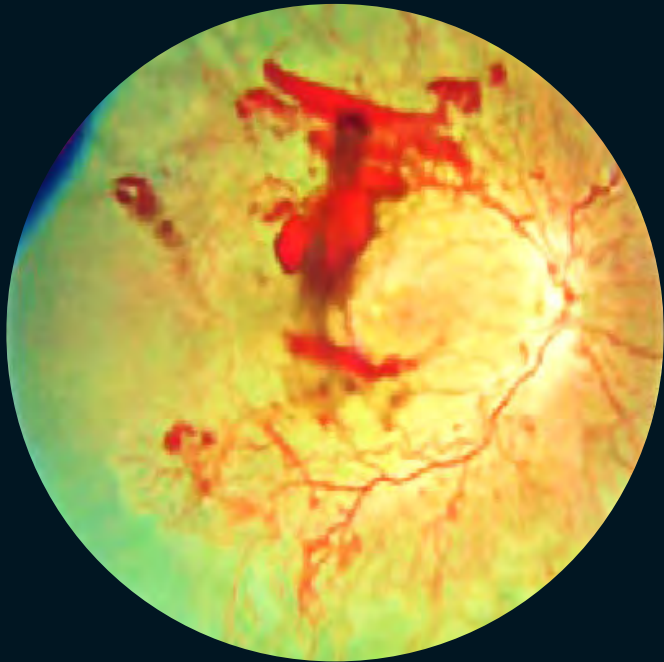
Both eyes at 1-week follow up showed reduced plus disease but persisting preretinal hemorrhage, more so in the right eye.

#### Outcome

Observe

At 1-month follow up the hemorrhages had significantly reduced and the vessels in both eyes were reaching Zone 3.





## APROP

### CASE 15: Continued follow up at 1-week (Montage imaging)

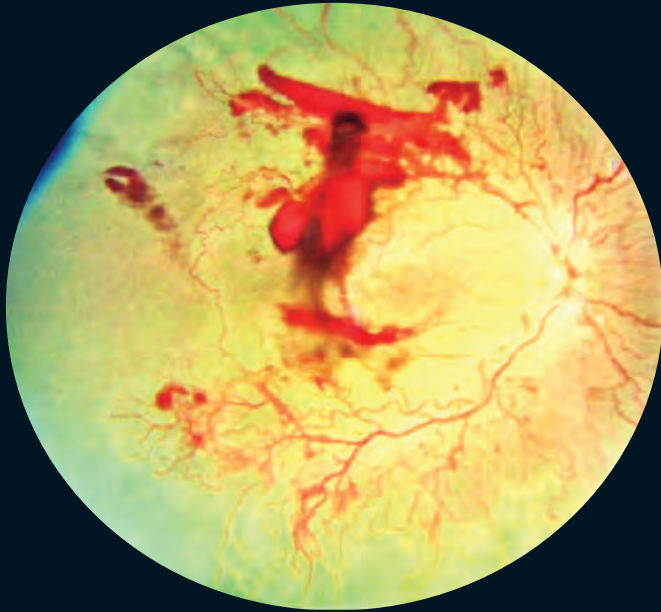
#### Description

Figure A (Right eye) Figure B (Left eye): Both eyes 1-week status post anti-VEGF injection for APROP. Both eyes show reduced plus disease and right eye shows preretinal hemorrhage. Right eye single image measured from the center gives widefield 133-degree wide by 133-degree high field of view (FOV). Left eye 2 images stitched together gives ultra-widefield 200-degree wide in one of the dimensions and by 133-degree high in the other dimension of the FOV.

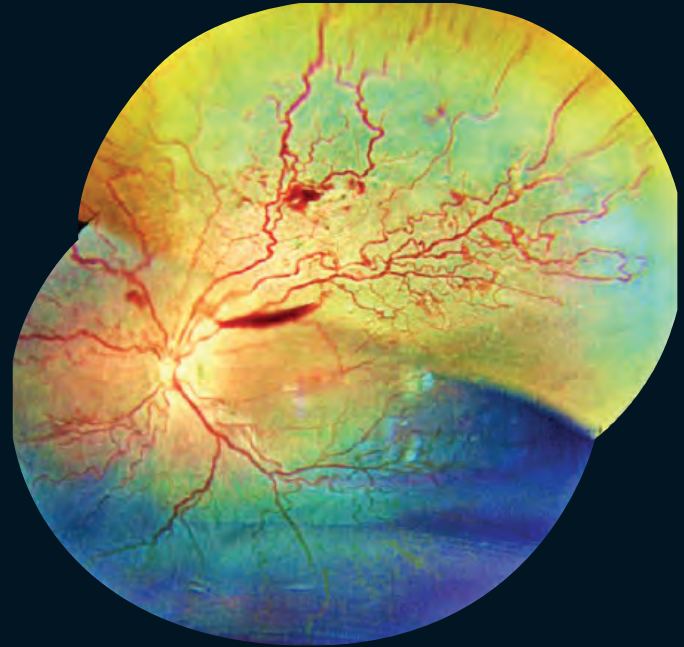
#### Outcome

Observe

At 1-month follow up the hemorrhages had significantly reduced and the vessels in both eyes were reaching Zone 3.



A



B

## APROP

### CASE 16: Montage imaging

#### History

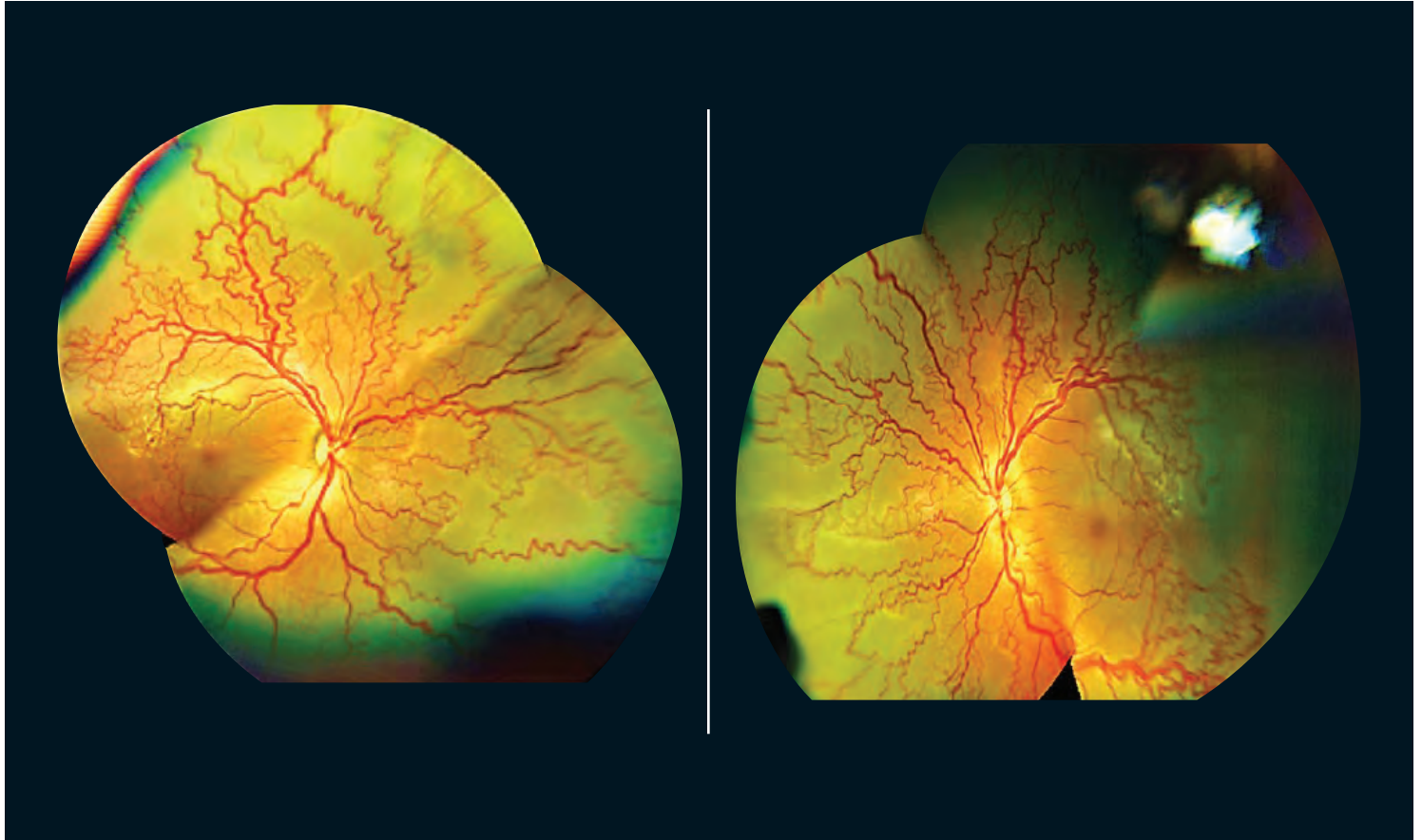
A preterm baby with gestational age 30 weeks, birth weight 1300 grams and post menstrual age 38 weeks.

#### Description

Both eyes Aggressive Posterior Retinopathy of Prematurity (APROP) with tortuous and dilated vessels in Zone 1 with extensive looping and shunting of vessels. Montage of 2 images stitched together in both eyes gives ultra-widefield 200-degree wide in one of the dimensions and by 133-degree high in the other dimension of the FOV. Lid artefacts are noted in the images.

#### Management

Baby was advised intravitreal anti-VEGF (anti-Vascular Endothelial Growth Factor) injection in both the eyes on the same day. Post injection follow up at 1-week showed reduced plus disease with decreasing tortuosity of vessels.



## APROP

### CASE 17

#### History

A preterm baby with gestational age 28 weeks, birth weight 1300 grams and post menstrual age 38 weeks.

#### Description

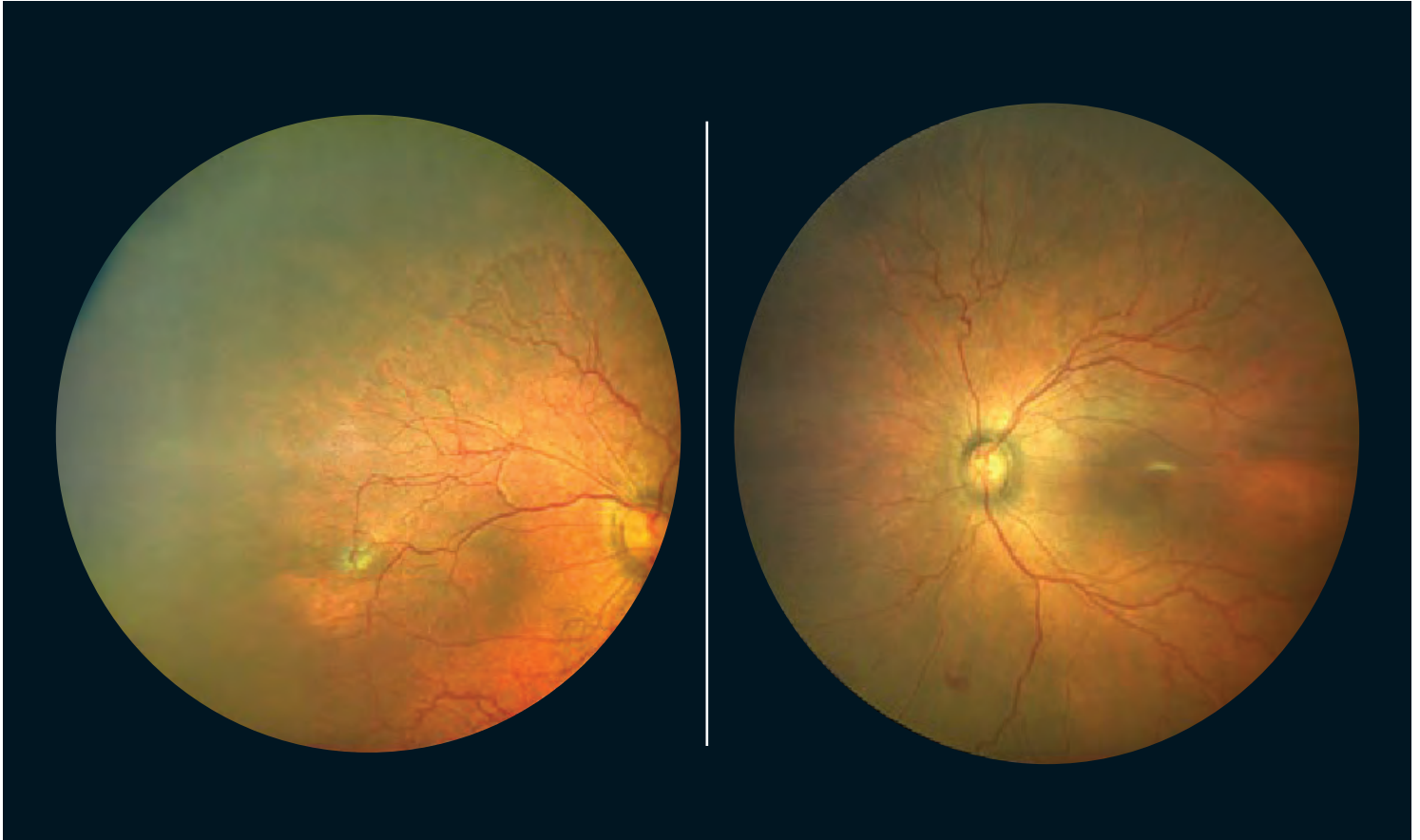
Both eyes status post anti-VEGF given 2 weeks ago now shows reduced plus disease with reduced tortuosity of vessels.

The right eye vessels are still in Zone 1 with just vascularized macula and left eye vessels are in Zone 2 posterior.

#### Outcome

Observe

At 3 weeks follow-up both the eyes showed slow rate of progression with vessels still in Zone 2. However the vascularity and plus disease had significantly reduced.



## APROP

### CASE 18

#### History

A preterm baby with gestational age 33 weeks, birth weight 1000 grams and post menstrual age 36 weeks.

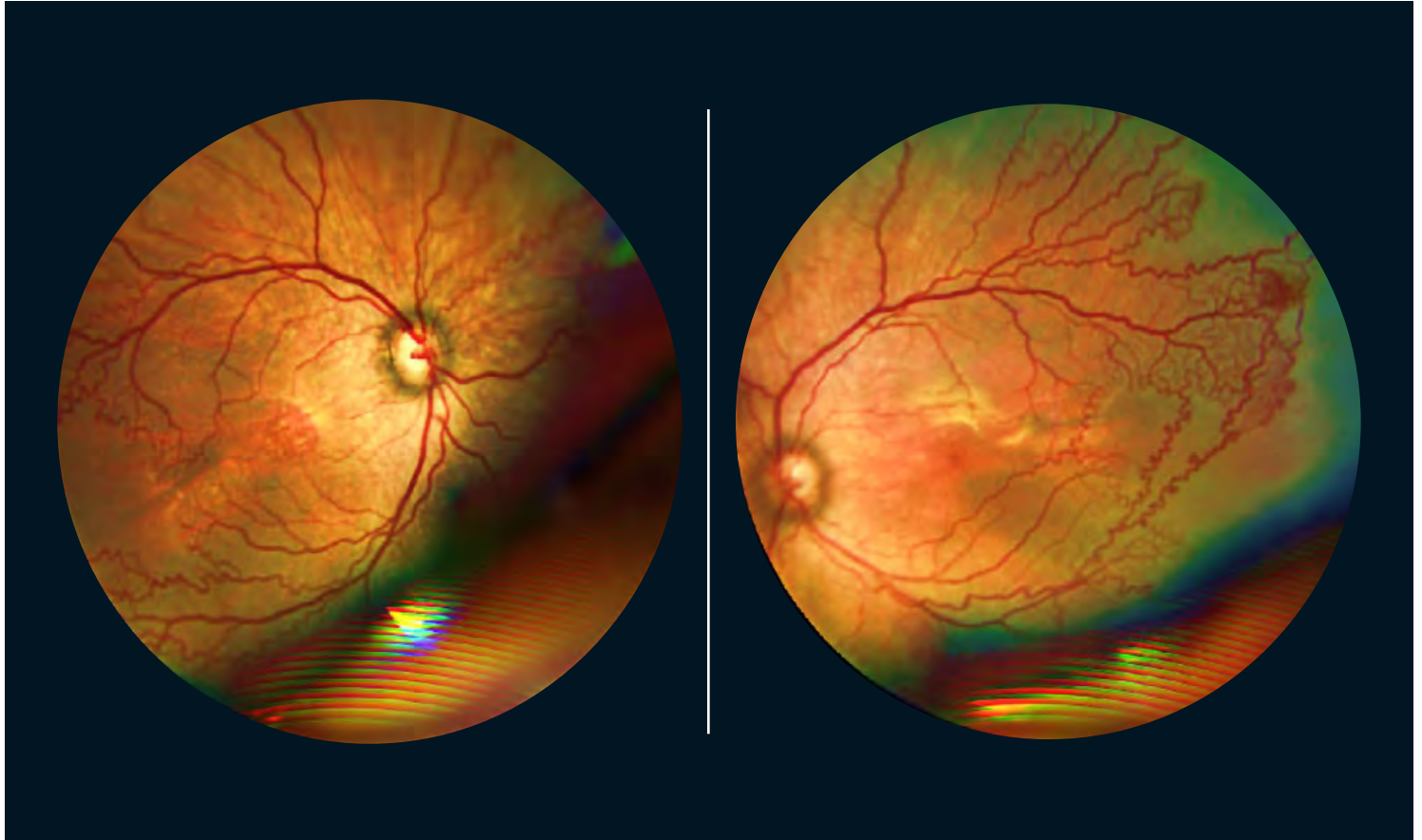
#### Description

Both eyes Aggressive Posterior Retinopathy of Prematurity (APROP) with dilated and tortuous vessels with looping and shunting which is very well appreciated in the temporal areas of the left eye. Both eyes show inferior lid artifacts.

#### Management

Baby was advised intravitreal anti-VEGF (anti-Vascular Endothelial Growth Factor) injection in both eyes on the same day. Post injection follow up at 1-week showed reduced plus disease with decreasing tortuosity of vessels. At 3-week follow-up the vascular loops had opened, and the vessels were advancing to Zone 2.





## APROP

### CASE 19

#### History

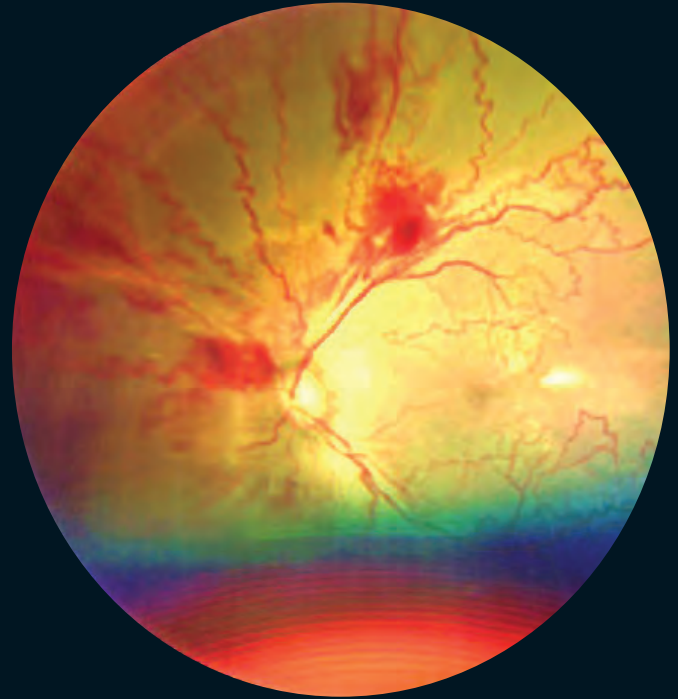
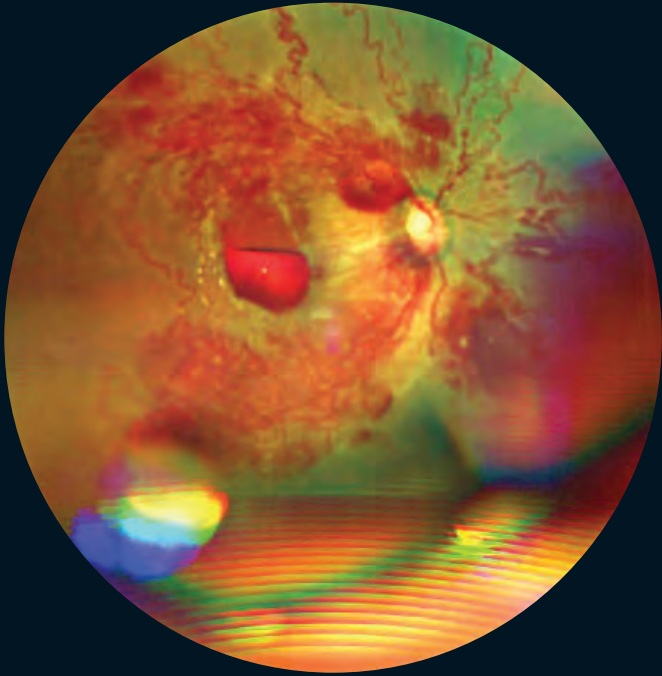
A preterm baby with gestational age 30 weeks, birth weight 1200 grams and post menstrual age 35 weeks.

#### Description

Both eyes Aggressive Posterior Retinopathy of Prematurity (APROP) with preretinal, sub-hyaloid hemorrhage. There are areas of extensive looping and shunting of vessels. Right eye shows plastered fibrin along the arcades and sclerosed vessels. Both eyes show lower lid artifacts.

#### Management

Baby was advised intravitreal anti-VEGF (anti-Vascular Endothelial Growth Factor) injection in both the eyes on the same day. Post injection follow up at 1-week showed reduced plus disease with decreasing tortuosity of vessels and reducing hemorrhages. At 3-week follow-up the vessels were advancing to Zone 2.



## APROP

### CASE 20

#### History

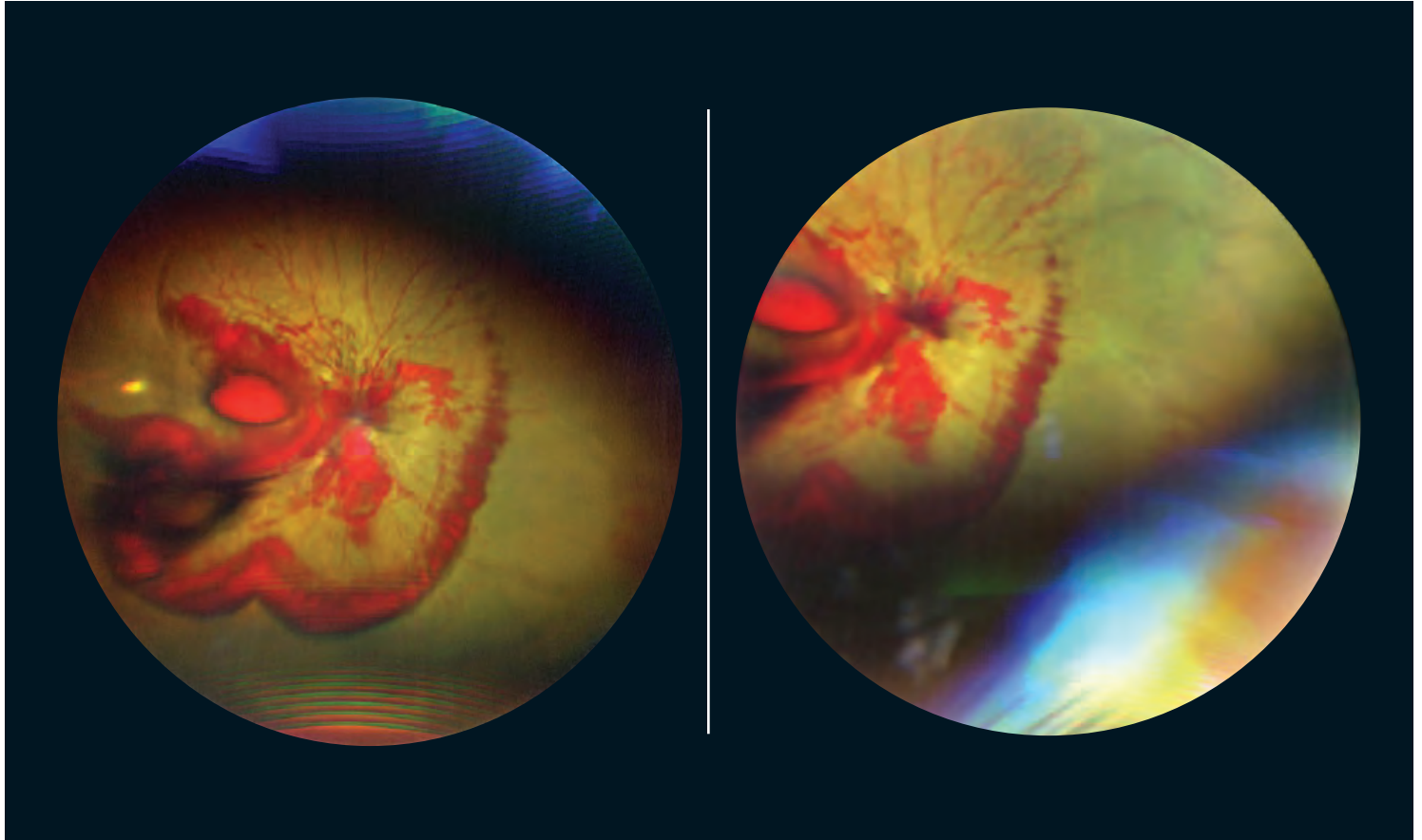
A preterm baby with gestational age 30 weeks, birth weight 1000 grams and post menstrual age 36 weeks.

#### Description

Right eye Aggressive Posterior Retinopathy of Prematurity (APROP) with preretinal, sub-hyaloid and vitreous hemorrhage covering predominantly the posterior pole. The vessels are still in Zone 1 and the macula is not completely vascularized. There is extensive peripheral avascular retina seen in both eyes.

#### Management

Baby was advised intravitreal anti-VEGF (anti-Vascular Endothelial Growth Factor) injection in both the eyes on the same day. Post injection follow up at 2 weeks showed reduced plus disease with decreasing tortuosity of vessels and resolving vitreous hemorrhage. At 1-month follow-up the baby received laser in both eyes by indirect ophthalmoscope.



## APROP

### CASE 20: Continued follow up at 1-month

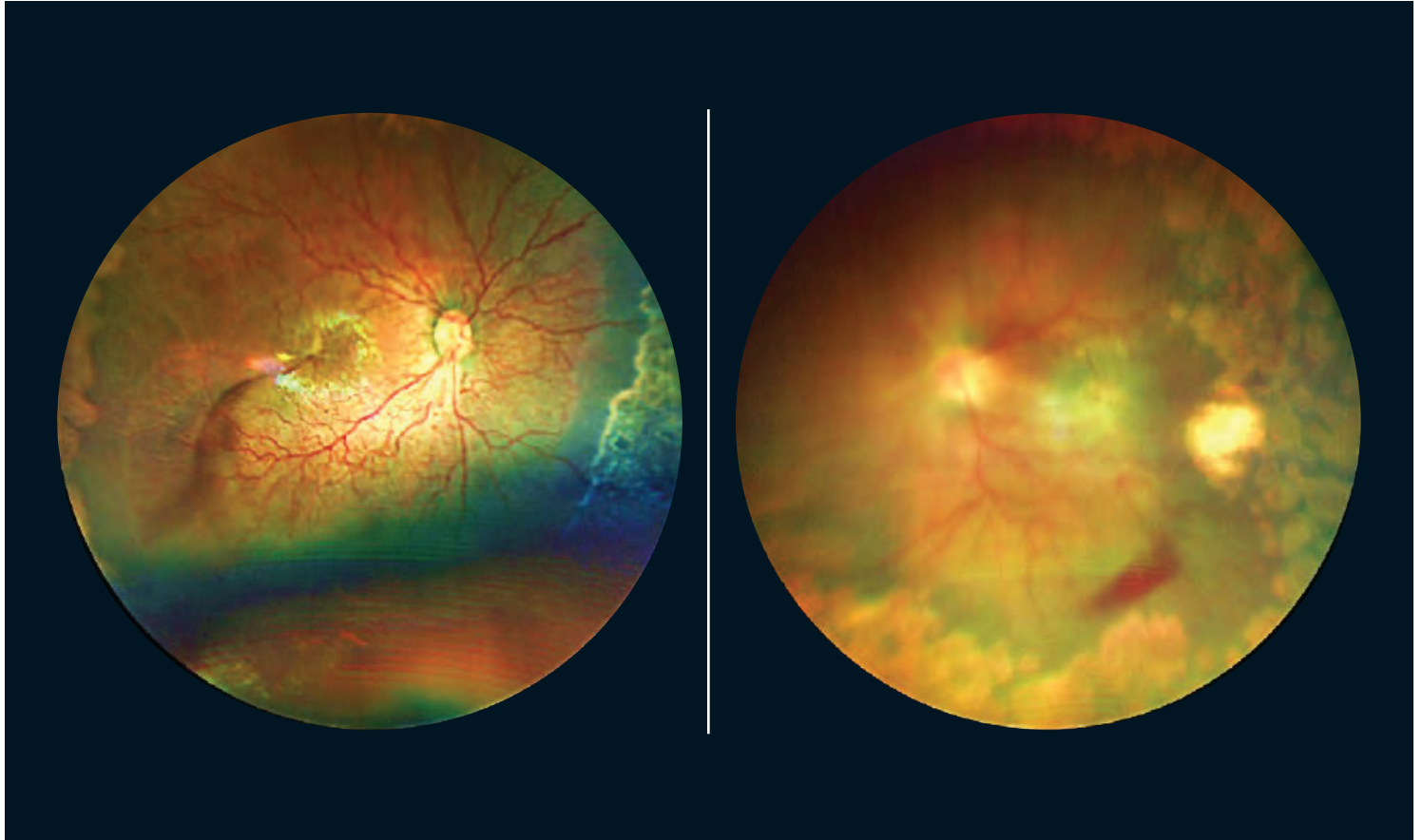
#### Description

Both eyes status post anti-VEGF and peripheral laser indirect ophthalmoscope scars with resolving vitreous hemorrhage.

There is still significant posterior activity with dilated and tortuous vessels indicating the need for additional sitting of laser.

#### Outcome

Post additional laser the Retinopathy of Prematurity (ROP) regressed in both eyes.



## APROP

### CASE 21

#### History

A preterm baby with gestational age 30 weeks, birth weight 1500 grams and post menstrual age 40 weeks.

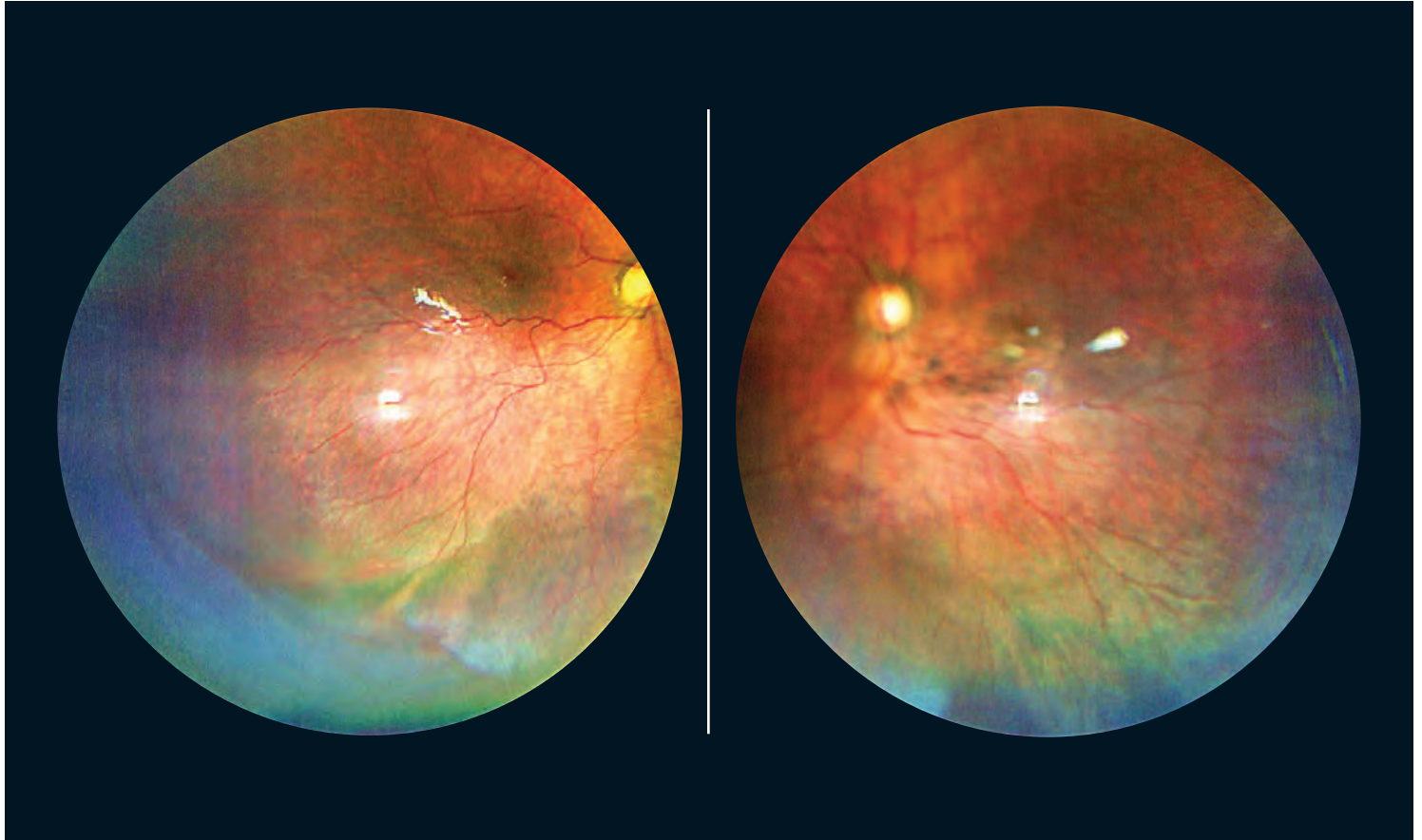
#### Description

Both eyes status post intravitreal anti-VEGF injection given 8 weeks back for Aggressive Posterior Retinopathy of Prematurity (APROP) showing reduced plus disease and the vessels are halting at Zone 2 anterior. Temporal periphery shows avascular retina in both eyes.

#### Management

The baby was advised peripheral laser to avascular retina in both the eyes. Post laser at 2 weeks follow-up the Retinopathy of Prematurity (ROP) in both eyes regressed.





## APROP

### CASE 22

#### History

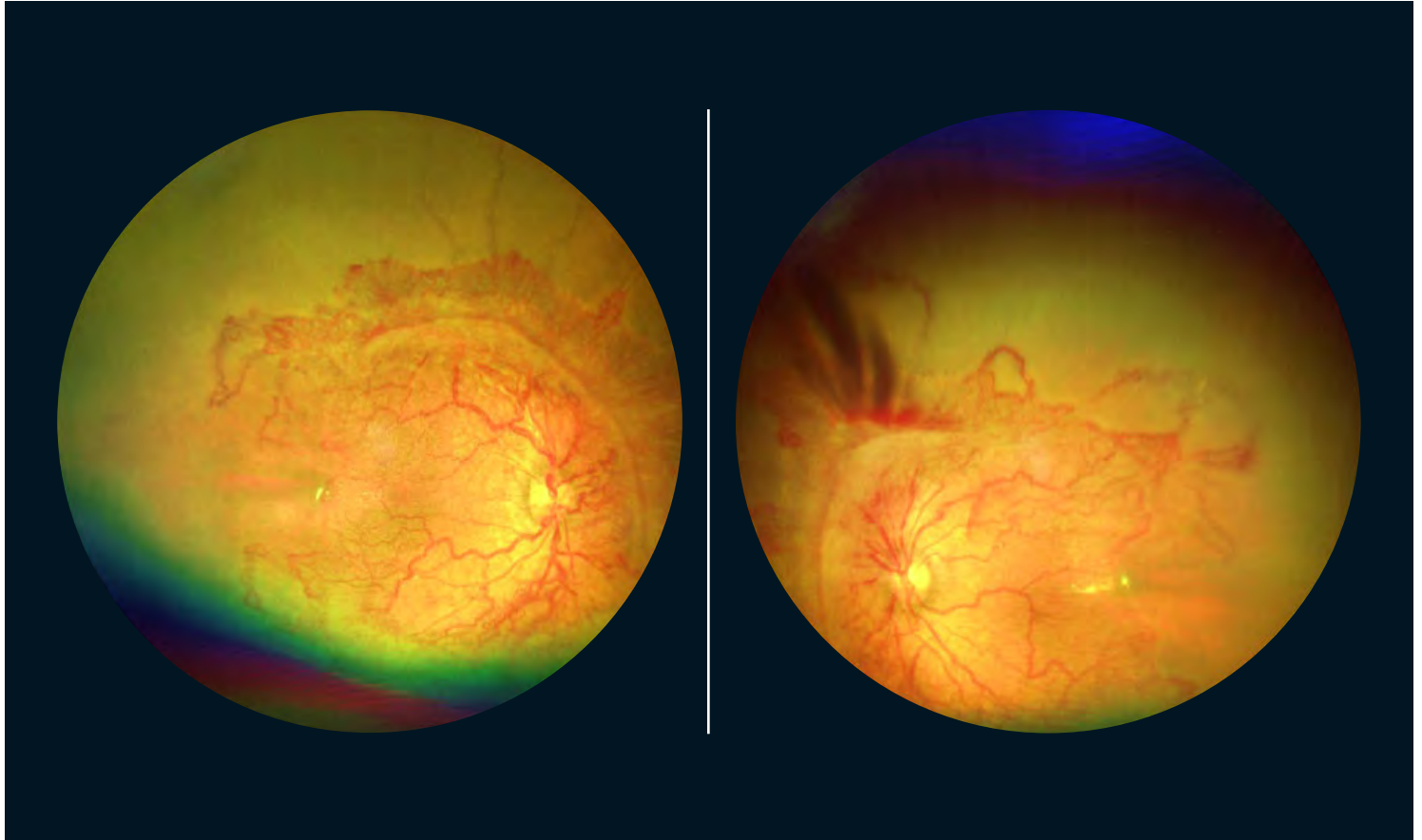
A preterm baby with gestational age 31 weeks, birth weight 1800 grams and post menstrual age 36 weeks.

#### Description

Both eyes Aggressive Posterior Retinopathy of Prematurity (APROP) with dilatation and tortuosity of vessels with Stage 3 fibrovascular proliferation in Zone 1 predominantly along the superior and supero-nasal arcade in both eyes and left eye shows minimal vitreous hemorrhage superiorly. Both eyes show extensive avascular retina. Both eyes macula is not yet completely vascularized. Right eye shows inferior lid artifacts and left eye with superior lid artifact.

#### Management

Baby was advised intravitreal anti-VEGF (anti-Vascular Endothelial Growth Factor) injection in both the eyes on the same day. At 1-week follow-up the tortuosity and dilatation of vessels had reduced. At 1-month follow-up the vessels were slowly progressing towards Zone 2 posterior.



## APROP

### CASE 23

#### History

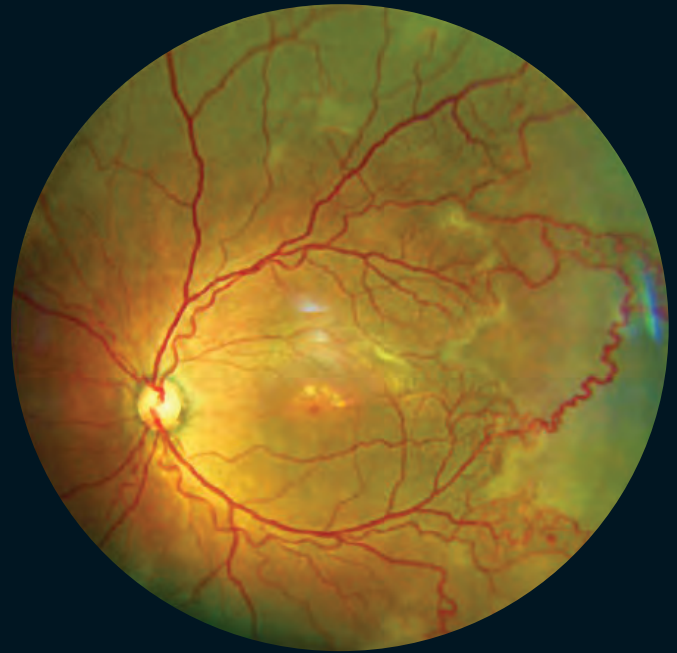
A preterm baby with gestational age 28 weeks, birth weight 1200 grams and post menstrual age 32 weeks.

#### Description

Both eyes Zone 1 Stage 2 ridge with Hybrid Retinopathy of Prematurity (ROP) with plus disease and looping and shunting seen temporally; more in left eye than right eye.

#### Management

Baby was advised intravitreal anti-VEGF (anti-Vascular Endothelial Growth Factor) injection in both the eyes on the same day. At 1-week follow-up the tortuosity and dilatation of vessels had reduced. At 3 weeks follow-up the loops had opened, and the vessels were advancing to Zone 2 anterior.



## APROP

### CASE 24

#### History

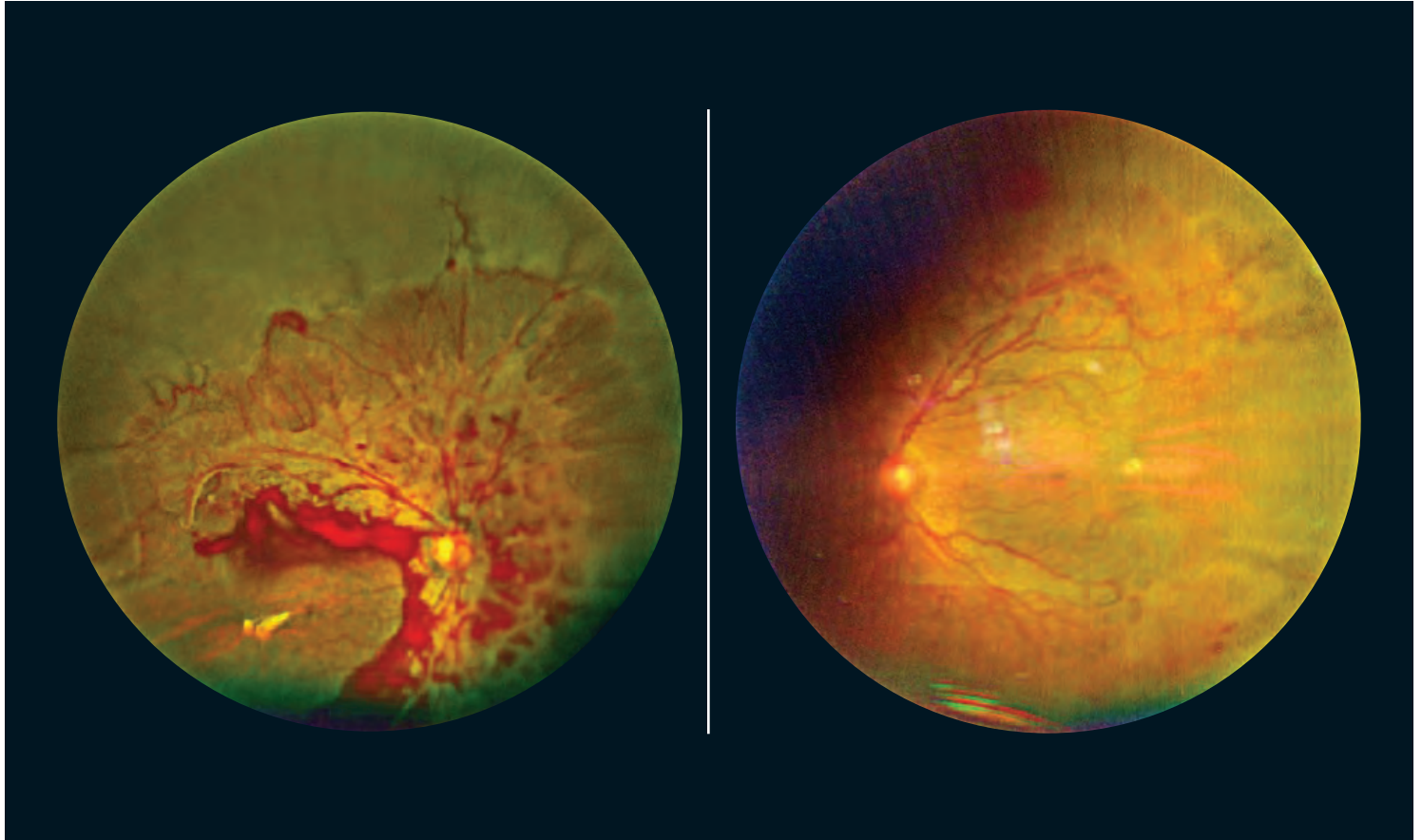
A preterm baby with gestational age 33 weeks, birth weight 1800 grams and post menstrual age 38 weeks.

#### Description

Both eyes Zone 1 Stage 3 Aggressive Posterior Retinopathy of Prematurity (APROP) with plus disease. Right eye also shows extensive pre-retinal hemorrhage and areas of vitreous condensation, right eye more severe than left eye. Both eyes macula is not yet completely vascularized and both eyes show extensive avascular retina.

#### Management

Baby was advised anti-VEGF in both eyes and called for review after 4 days. This case needed much closer observation since there is high chance of anti-VEGF induced traction due to Crunch. The baby needed a vitreoretinal surgery in the right eye due to the traction at the arcade and non resolving vitreous hemorrhage.



## APROP

### CASE 25

#### History

A preterm baby with gestational age 32 weeks, birth weight 1000 grams and post menstrual age 39 weeks.

#### Description

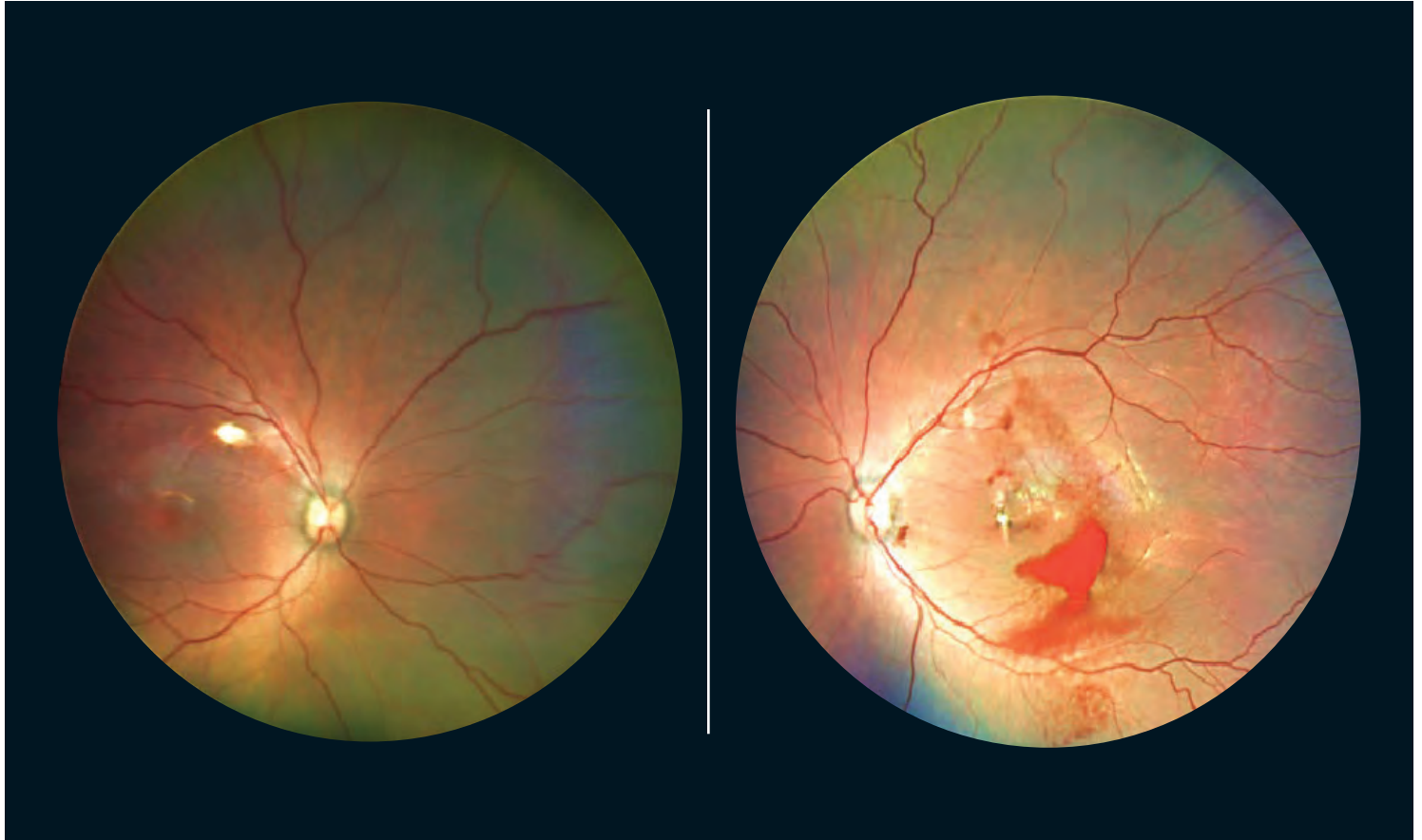
Both eyes Aggressive Posterior Retinopathy of Prematurity (APROP) 1-week status post intravitreal anti-VEGF injection shows reduced plus disease with decreased tortuosity of vessels and vessels are now going to Zone 2. However, LE had preretinal hemorrhage.

#### Management

Observe

At 1-month, left eye preretinal hemorrhage resolved and the vessels advanced to Zone 3 in both the eyes. Both eyes did not require any further intervention.





## APROP

### CASE 26

#### History

A preterm baby with gestational age 34 weeks, birth weight 2100 grams and post menstrual age 39 weeks.

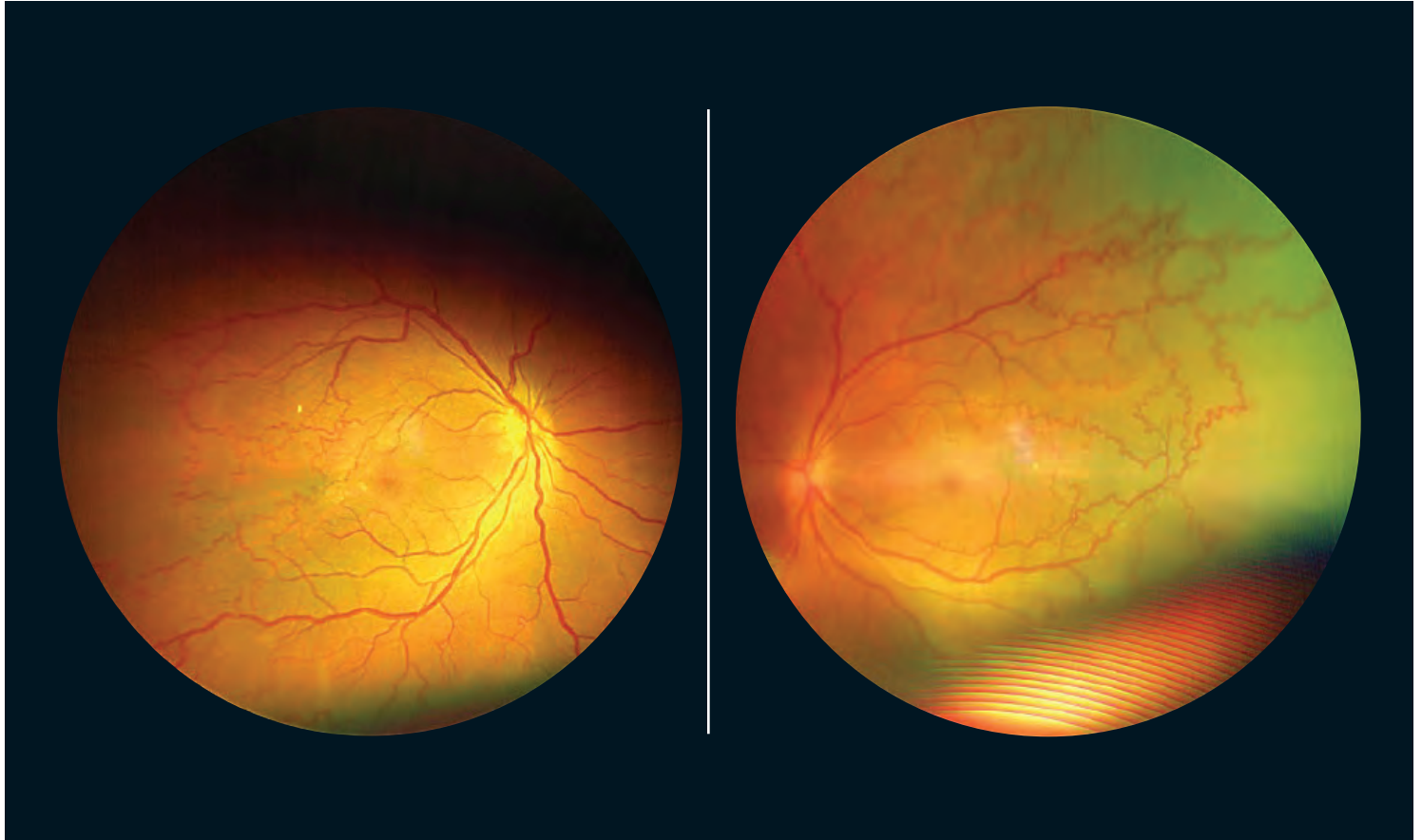
#### Description

Both eyes show Aggressive Posterior Retinopathy of Prematurity (APROP) with looping and shunting of vessels. Left eye appears more severe than right eye. Right eye shows superior lid artifact and left eye shows inferior lid artifact.

The macula is just vascularized.

#### Management

Baby was advised intravitreal anti-VEGF (anti-Vascular Endothelial Growth Factor) injection in both the eyes on the same day. Post injection follow up at 1-week showed reduced plus disease with decreasing tortuosity of vessels and reducing hemorrhages. At 3-week follow-up the loops had opened, and the vessels were advancing to Zone 2 anterior.



## APROP

### CASE 27

#### History

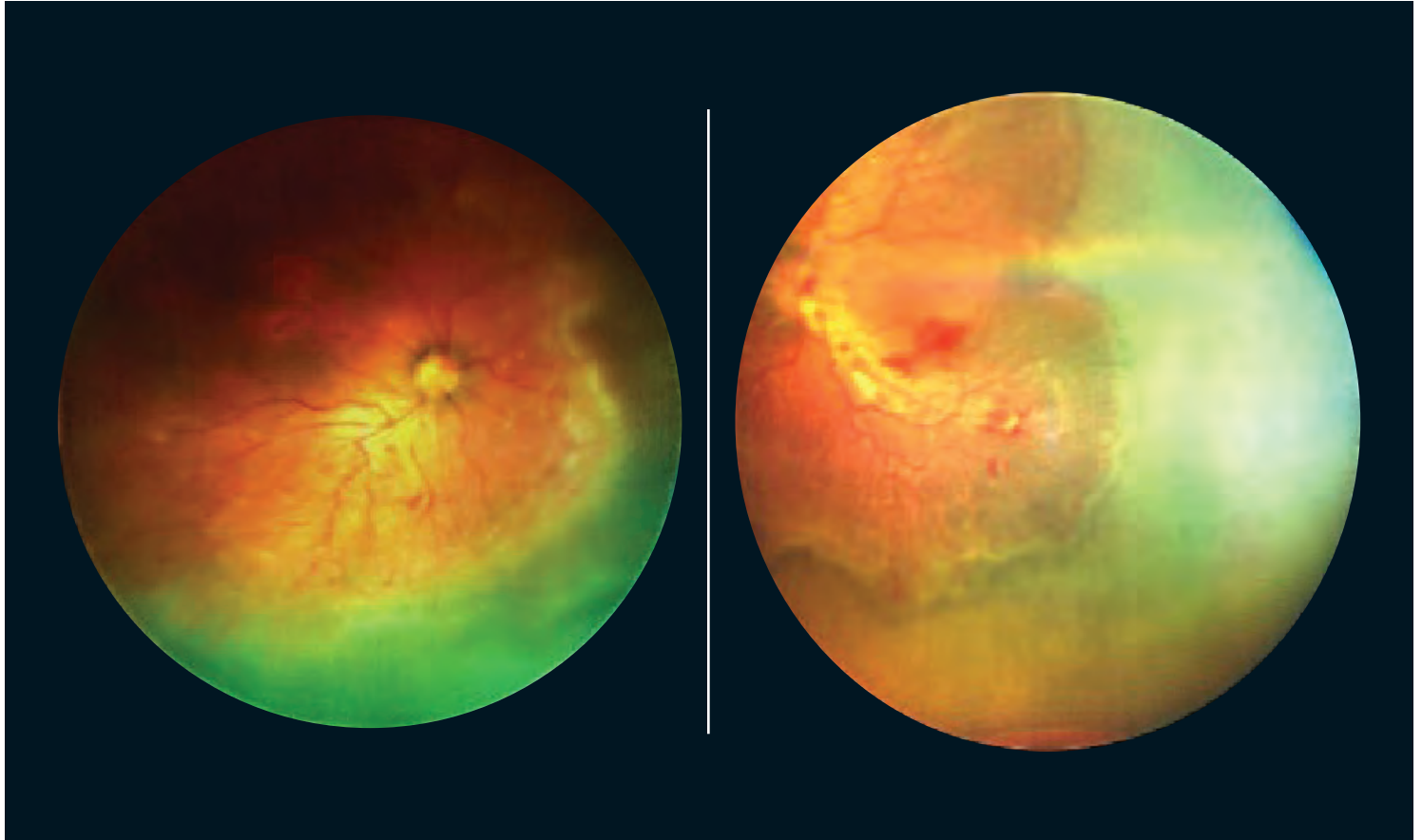
A preterm baby with gestational age 28 weeks, birth weight 1000 grams and post menstrual age 34 weeks.

#### Description

Both eyes Aggressive Posterior Retinopathy of Prematurity (APROP) with dilatation and tortuosity of vessels and minimal preretinal heme with extensive Stage 3 fibrovascular and neovascular proliferation in Zone 1. The macula is not yet completely vascularized and there is extensive peripheral avascular areas.

#### Management

Baby was advised intravitreal anti-VEGF (anti-Vascular Endothelial Growth Factor) injection in both the eyes on the same day. At 1-week follow-up the tortuosity and dilatation of vessels had reduced. At 1-month follow-up the vessels were slowly progressing towards Zone 2 posterior.



## APROP

### CASE 28

#### History

A preterm baby with gestational age 27 weeks, birth weight 900 grams and post menstrual age 37 weeks.

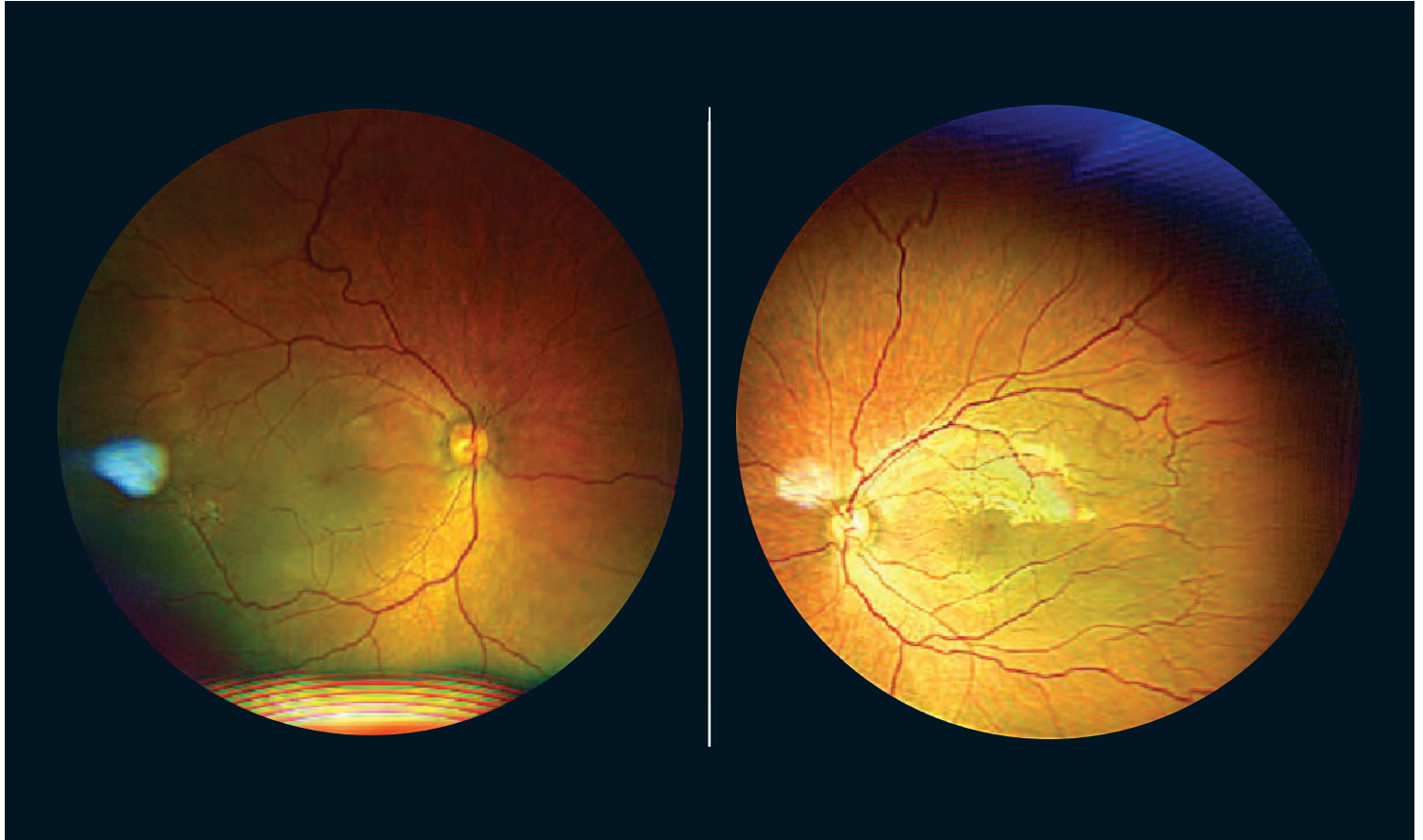
#### Description

Both eyes Aggressive Posterior Retinopathy of Prematurity (APROP) s/p bevacizumab 2 weeks ago, the tortuosity and dilatation of vessels has reduced with vessels now going to Zone 2 anterior. Right eye shows inferior lid artifact.

#### Management

Observe

At 1-month the plus disease significantly reduced with the vessels now advancing to Zone 3.



## APROP

### CASE 29

#### History

A preterm baby with gestational age 31 weeks, birth weight 1700 grams and post menstrual age 35 weeks.

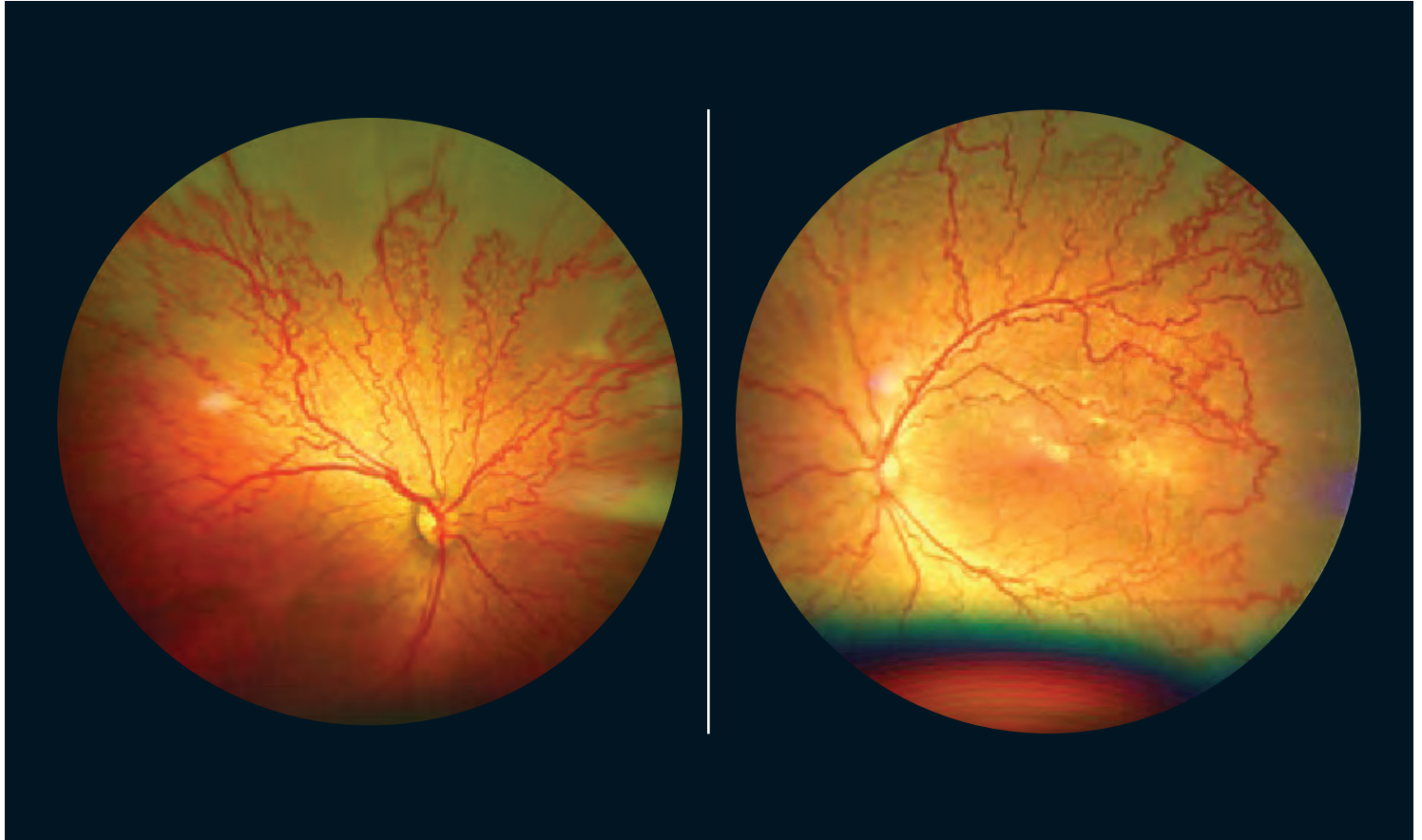
#### Description

Both eyes Aggressive Posterior Retinopathy of Prematurity (APROP) with dilatation and tortuosity of vessels with extensive looping and shunting of vessels. Left eye shows inferior lid artifact.

#### Management

Baby was advised intravitreal anti-VEGF (anti-Vascular Endothelial Growth Factor) injection in both the eyes on the same day. Post injection follow up at 1-week showed reduced plus disease with decreasing tortuosity of vessels. At 3-week follow-up the vascular loops had opened, and the vessels were advancing to Zone 2.





## APROP

### CASE 30

#### History

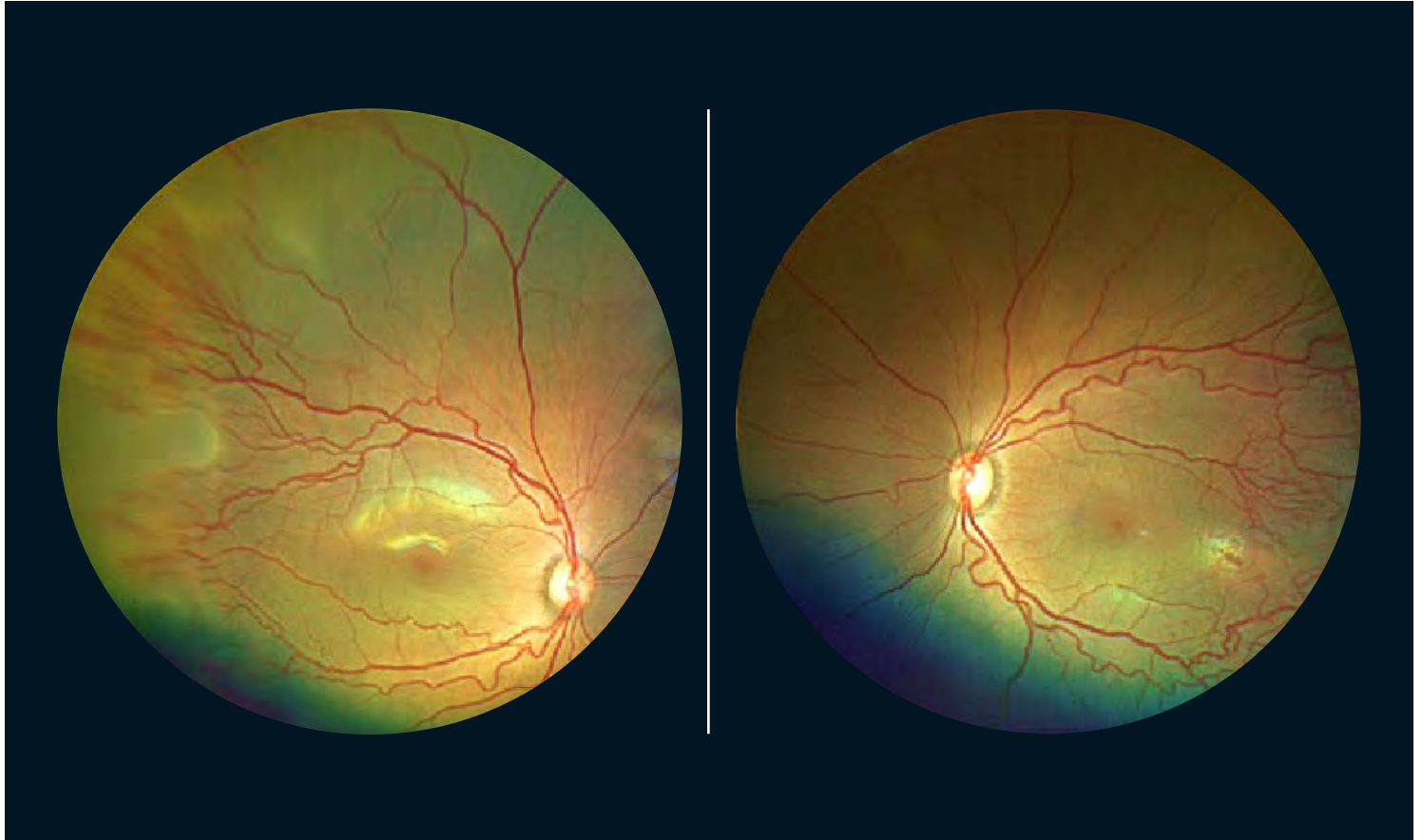
A preterm baby with gestational age 30 weeks, birth weight 1800 grams and post menstrual age 35 weeks.

#### Description

Both eyes Zone 2 posterior Stage 3 Hybrid plus Retinopathy of Prematurity (ROP) with temporal looping and shunting of vessels with ridge formation.

#### Management

Baby was advised intravitreal anti-VEGF (anti-Vascular Endothelial Growth Factor) injection in both the eyes on the same day. Post injection follow up at 1-week showed reduced plus disease with decreasing tortuosity of vessels. At 3-week follow-up the vascular loops had opened, and the vessels were advancing to Zone 2.



## APROP

### CASE 31

#### History

A preterm baby with gestational age 26 weeks, birth weight 1000 grams and post menstrual age 34 weeks.

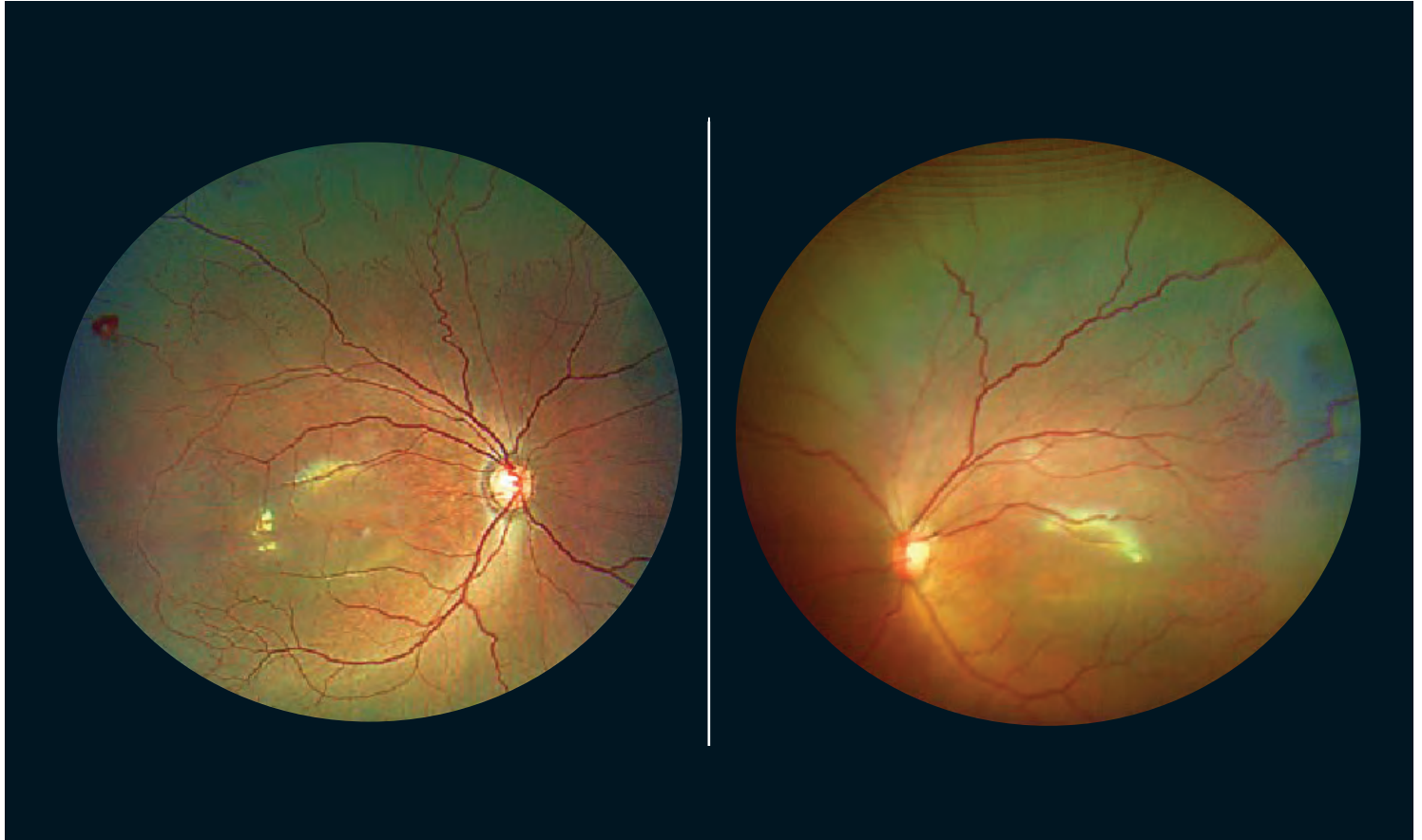
#### Description

Both eyes Aggressive Posterior Retinopathy of Prematurity (APROP) status post anti-VEGF 1-week ago showing reduced tortuosity and the loops have opened allowing vessels to travel to Zone 2 now.

#### Management

Observe

At 3-week follow-up the tortuosity had further reduced, and the vessels were advanced to Zone 3.



## APROP

### CASE 32

#### History

A preterm baby with gestational age 30 weeks, birth weight 1000 grams and post menstrual age 38 weeks.

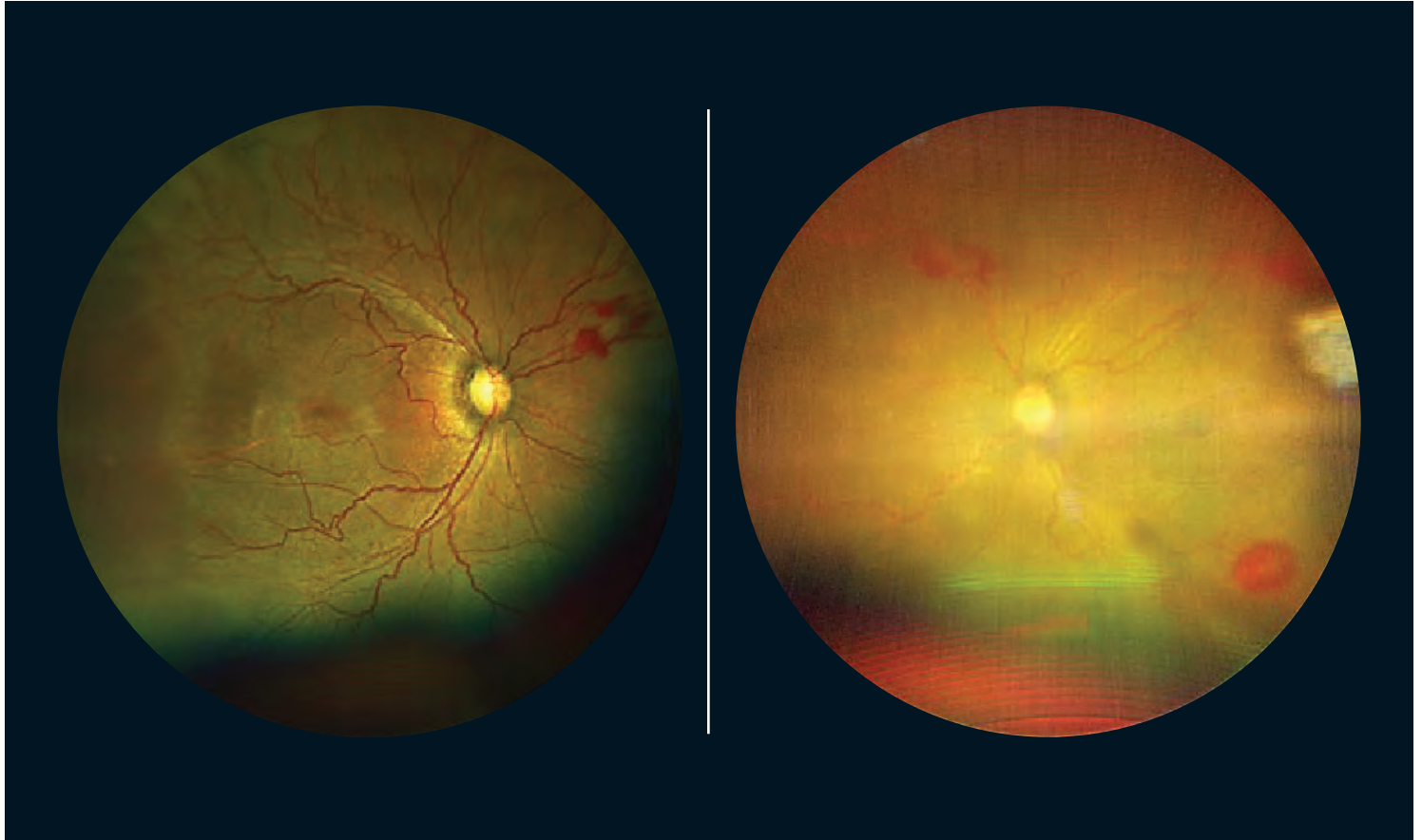
#### Description

Both eyes Aggressive Posterior Retinopathy of Prematurity (APROP) status post anti-VEGF given 1-week ago now shows reduced plus with decreasing vascular tortuosity and few preretinal hemorrhages. Left eye media is hazier than right eye.

#### Management

Observe

At 3-week follow-up the tortuosity had reduced further, and the hemorrhages had resolved, but the vascular progression was on a slower side with vessels still in Zone 2 posterior.



## APROP

### CASE 33

#### History

A preterm baby with gestational age 28 weeks, birth weight 1000 grams and post menstrual age 44 weeks.

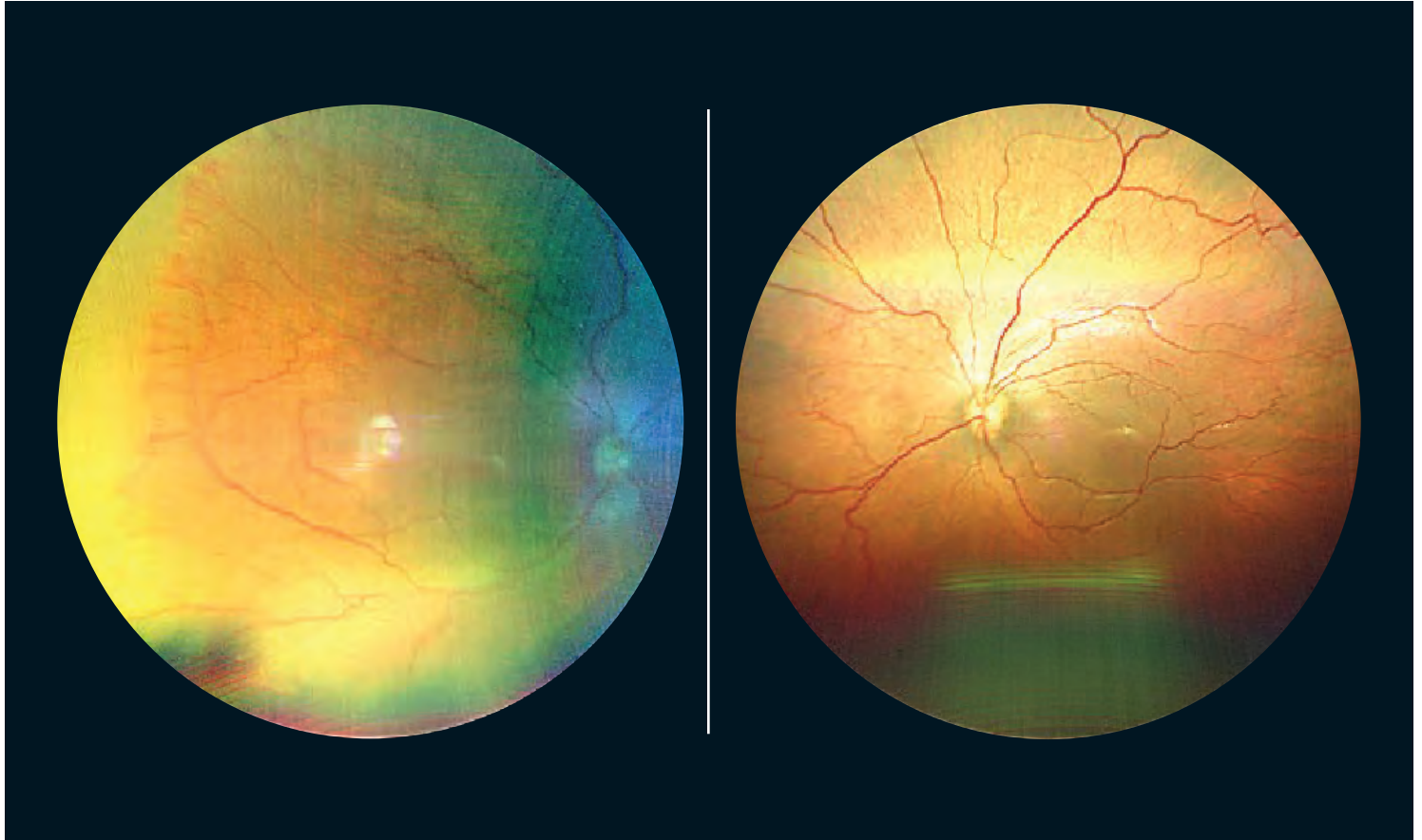
#### Description

Both eyes Aggressive Posterior Retinopathy of Prematurity (APROP) status post anti-VEGF given 12 weeks ago, has recurrence of neovascularization and tortuosity.

#### Management

The baby was treated both eyes with laser. Two weeks post laser the ROP regressed.





## APROP

### CASE 34

#### History

A preterm baby with gestational age 30 weeks, birth weight 1000 grams and post menstrual age 38 weeks.

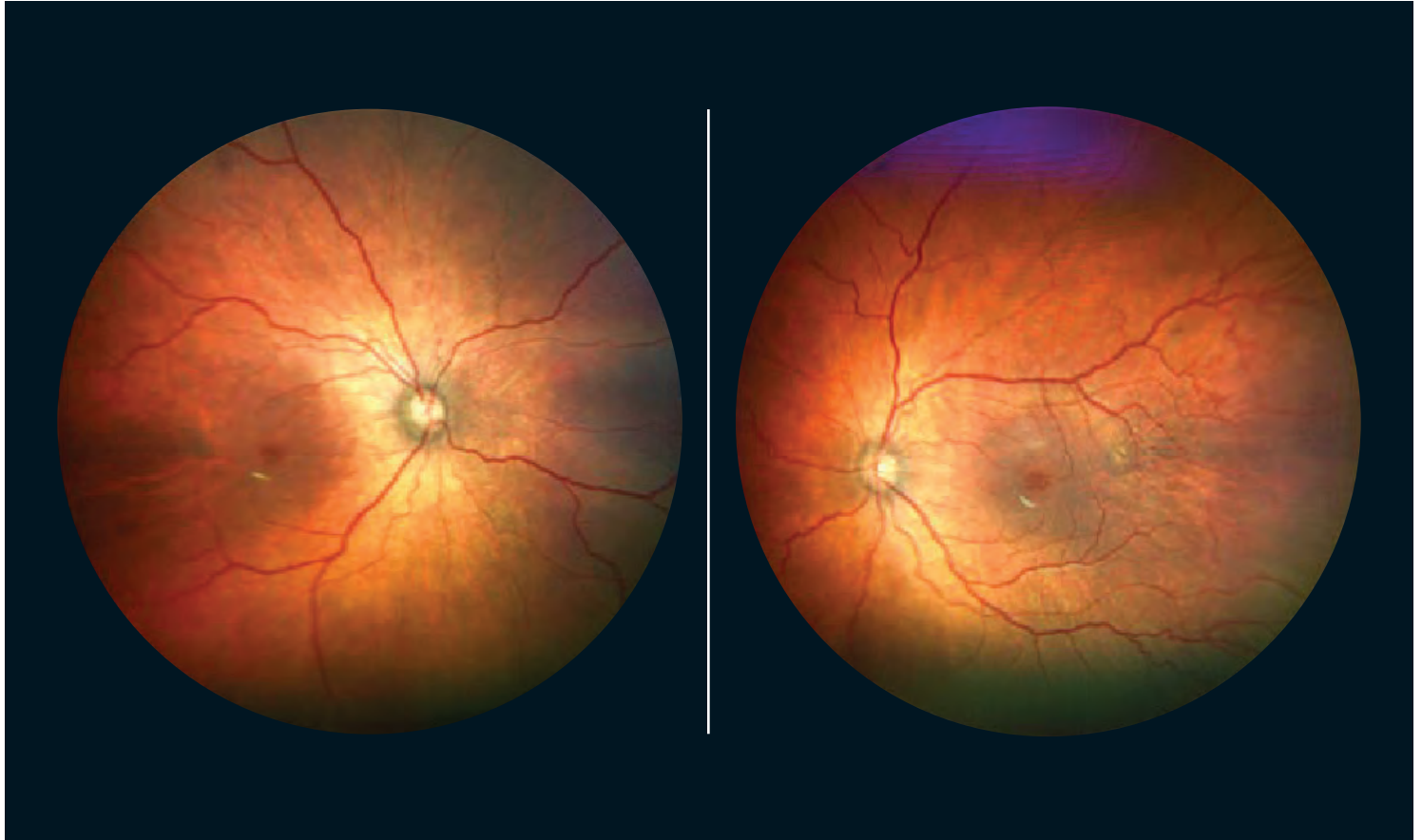
#### Description

Both eyes Aggressive Posterior Retinopathy of Prematurity (APROP) status post anti-VEGF given 1-week ago shows reduced plus disease with decreasing vascular tortuosity. The vessels are now going to Zone 2 anterior.

#### Management

Observe

At 1-month follow-up the vascularity and tortuosity had further reduced, and the vessels were going to Zone 3 now.



## APROP

### CASE 35

#### History

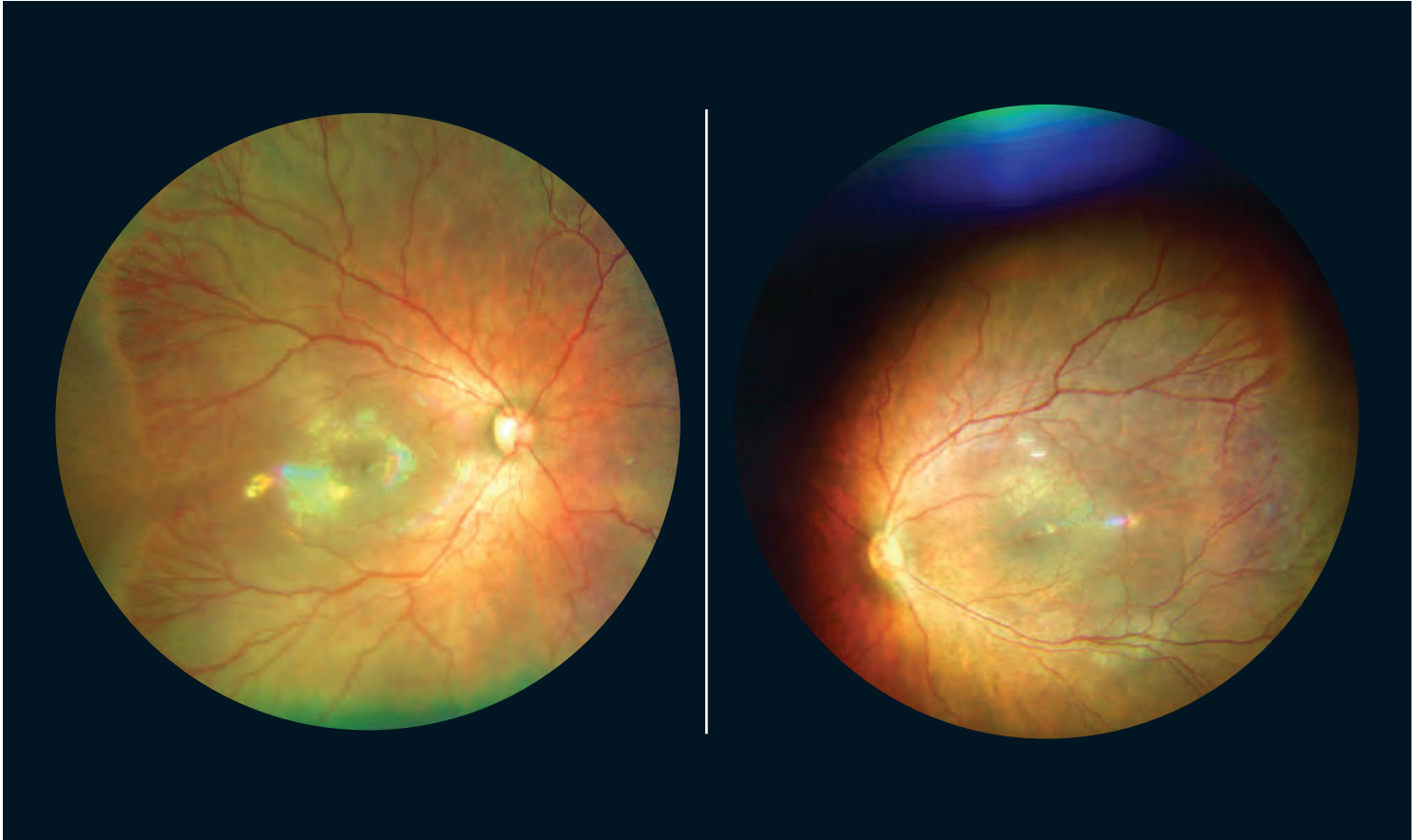
A preterm baby with gestational age 30 weeks, birth weight 1100 grams and post menstrual age 46 weeks.

#### Description

Both eyes Aggressive Posterior Retinopathy of Prematurity (APROP) status post anti-VEGF given 12 weeks ago now shows recurrence of neovascular tufts temporally and increased tortuosity and dilatation of vessels.

#### Management

Baby was advised for both eyes laser and called for review after 2 weeks post laser. During the subsequent follow-up, the ROP was on a regressing course.



## APROP

### CASE 36

#### History

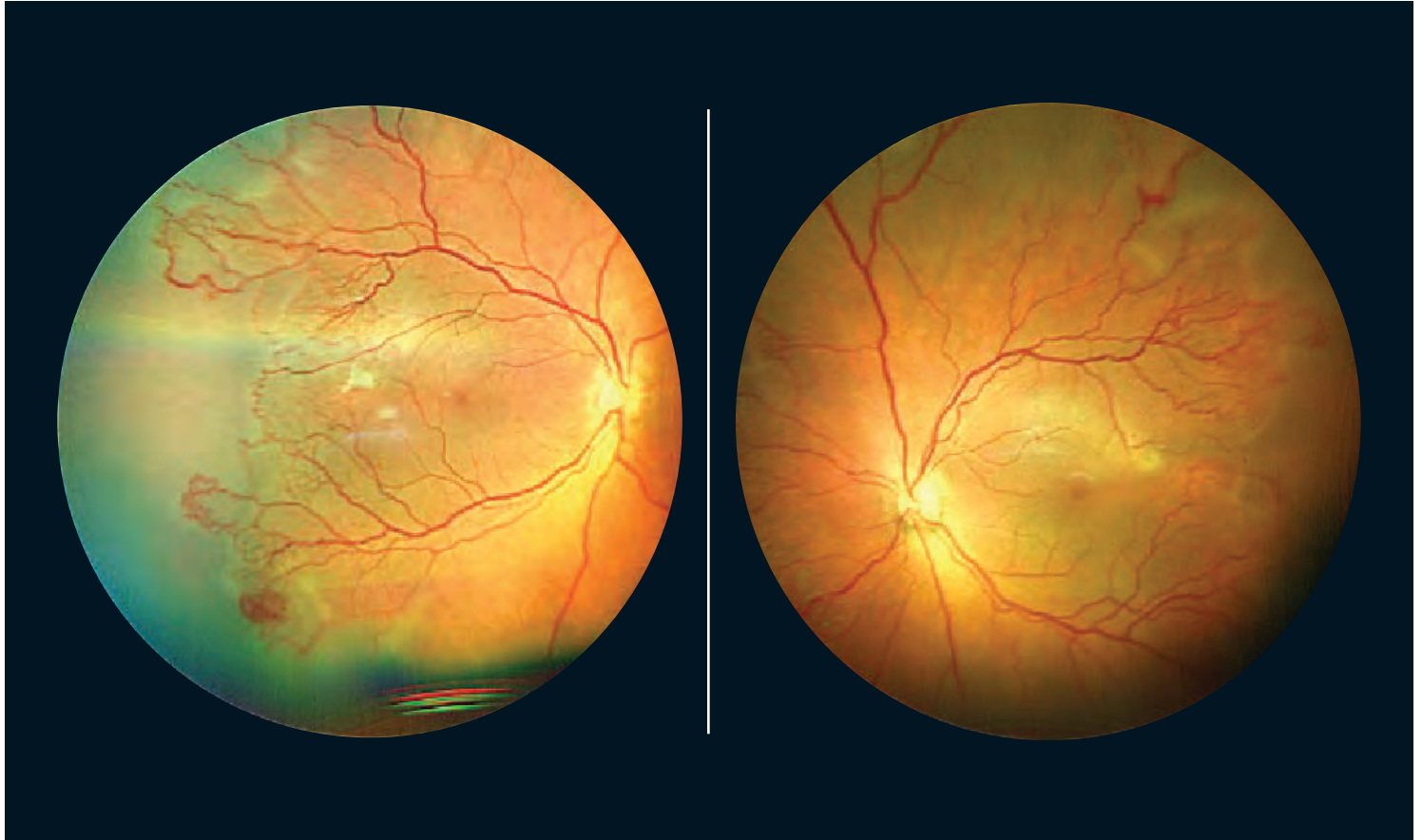
A preterm baby with gestational age 27 weeks, birth weight 1500 grams and post menstrual age 33 weeks.

#### Description

Both eyes Hybrid Retinopathy of Prematurity (ROP) with Zone 2 posterior Stage 2-3 plus disease with temporal ridge and neovascular tufts and areas of avascular peripheral retina. The macula is just vascularized.

#### Management

Baby was advised intravitreal anti-VEGF (anti-Vascular Endothelial Growth Factor) injection in both the eyes on the same day. Post injection follow up at 1-week showed reduced plus disease, decreasing tortuosity of vessels and reducing neovascular fronds. At 1-month follow-up the vessels were progressing to Zone 2 anterior.



## APROP

### CASE 37

#### History

A preterm baby with gestational age 35 weeks, birth weight 2000 grams and post menstrual age 45 weeks.

#### Description

Both eyes Hybrid Retinopathy of Prematurity (ROP) status post anti-VEGF injection given 1-month ago now shows reduced tortuosity and dilatation of vessels and the vessels are going to Zone 2 anterior now.

#### Management

Observe

At 1-month follow-up the vessels were progressing to Zone 3 with significant reduction in plus disease.





## APROP

### CASE 38

#### History

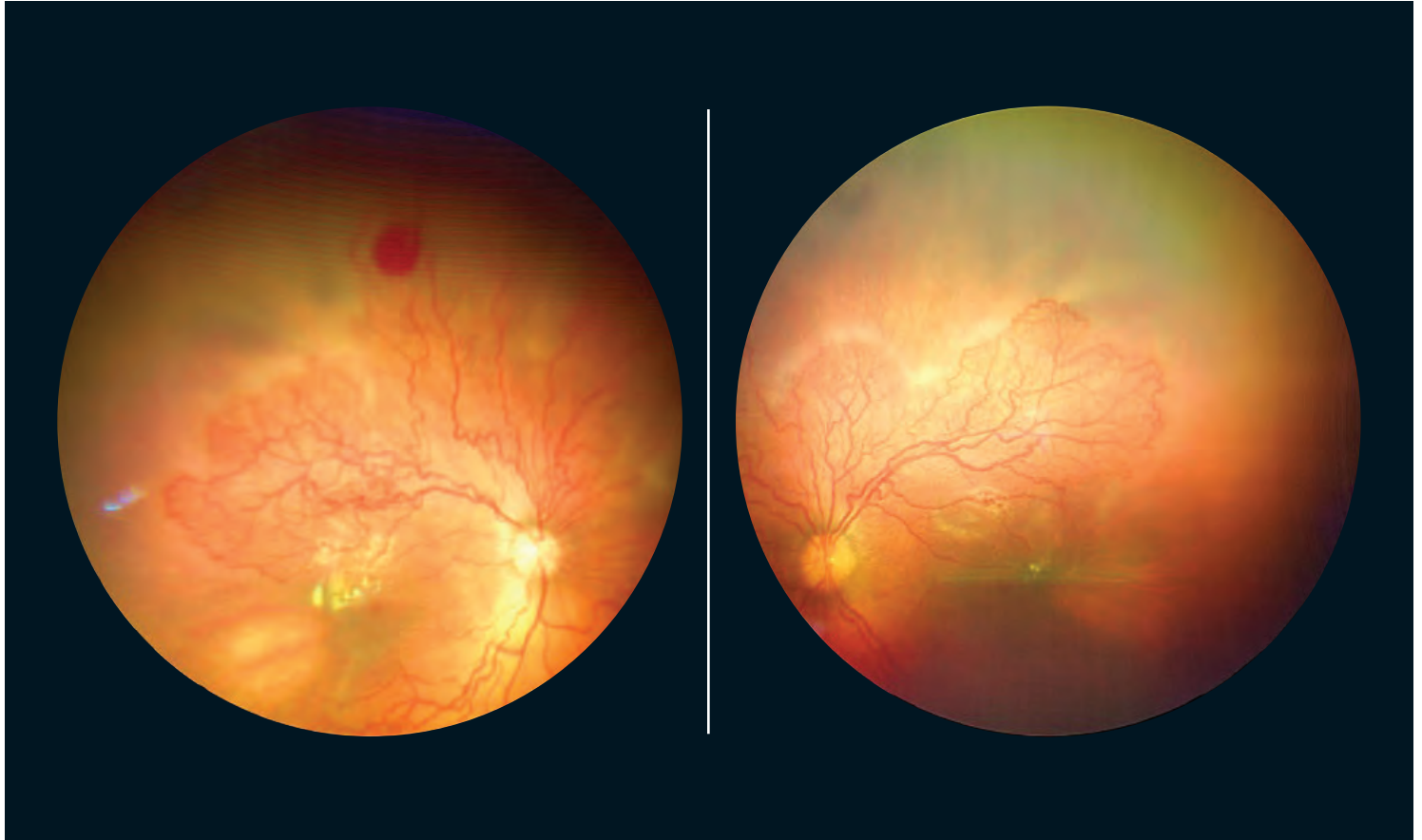
A preterm baby with gestational age 28 weeks, birth weight 1400 grams and post menstrual age 33 weeks.

#### Description

Both eyes Aggressive Posterior Retinopathy of Prematurity (APROP) with extensive looping and shunting of vessels and neovascular tufts. Both eyes show extensive superior avascular retina and the right eye in addition showed superior retinal hemorrhage. The macula is not yet completely vascularized.

#### Management

Baby was advised intravitreal anti-VEGF (anti-Vascular Endothelial Growth Factor) injection in both the eyes on the same day. Post injection follow up at 1-week showed reduced plus disease with decreasing tortuosity of vessels. At 3-week follow-up the vascular loops had opened, and the vessels were advancing to Zone 2.



## APROP

### CASE 39

#### History

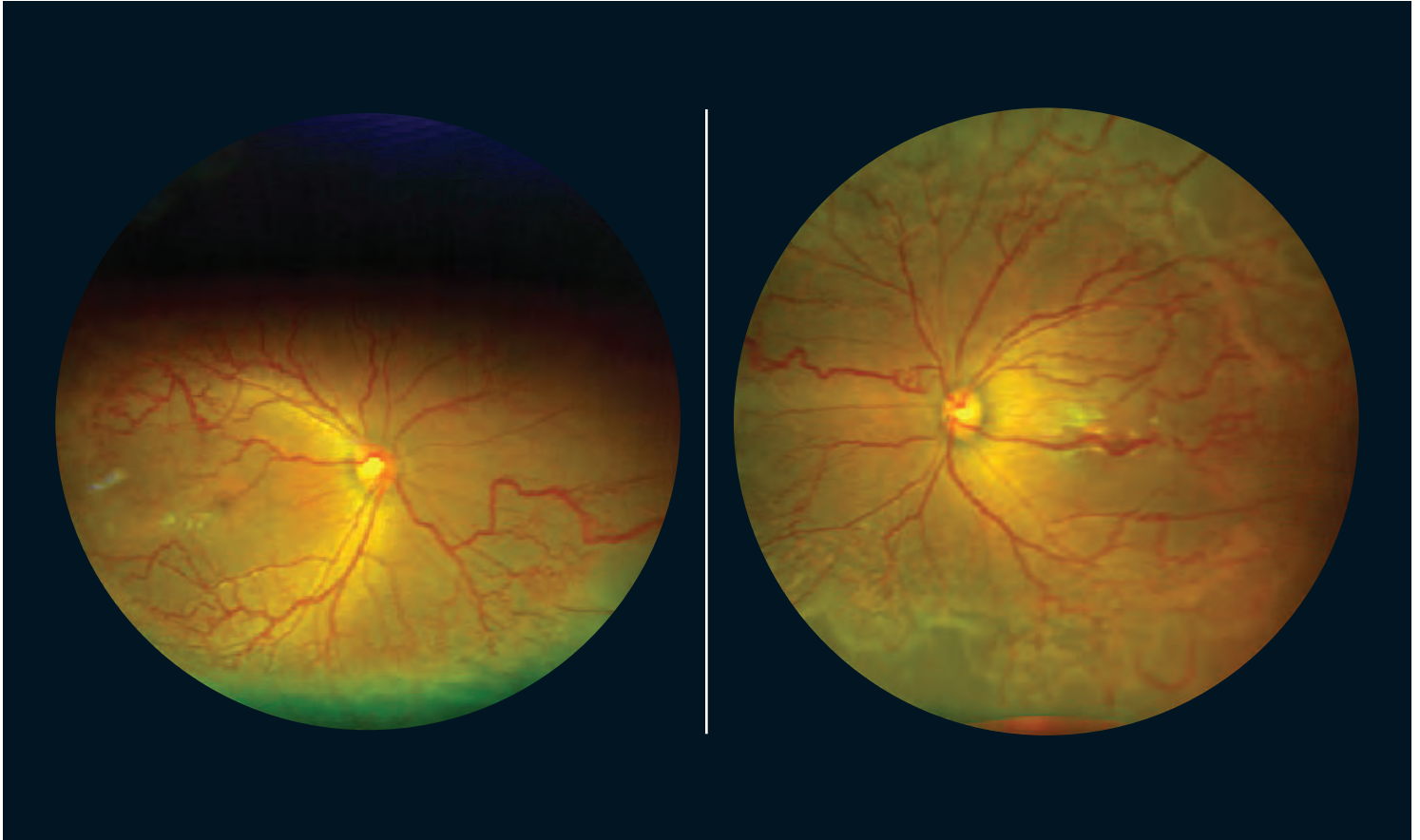
A preterm baby with gestational age 34 weeks, birth weight 1700 grams and post menstrual age 39 weeks.

#### Description

Both eyes Aggressive Posterior Retinopathy of Prematurity (APROP) with Zone 2 posterior Stage 3 plus disease with areas of vascular looping, shunting and neovascularization. The macula is just vascularized.

#### Management

Baby was advised intravitreal anti-VEGF (anti-Vascular Endothelial Growth Factor) injection in both the eyes on the same day. Post injection follow up at 1-week showed reduced plus disease with decreasing tortuosity of vessels. At 3-week follow-up the vascular loops had opened, and the vessels were advancing to Zone 2.



## APROP

### CASE 40

#### History

A preterm baby with gestational age 28 weeks, birth weight 1200 grams and post menstrual age 38 weeks.

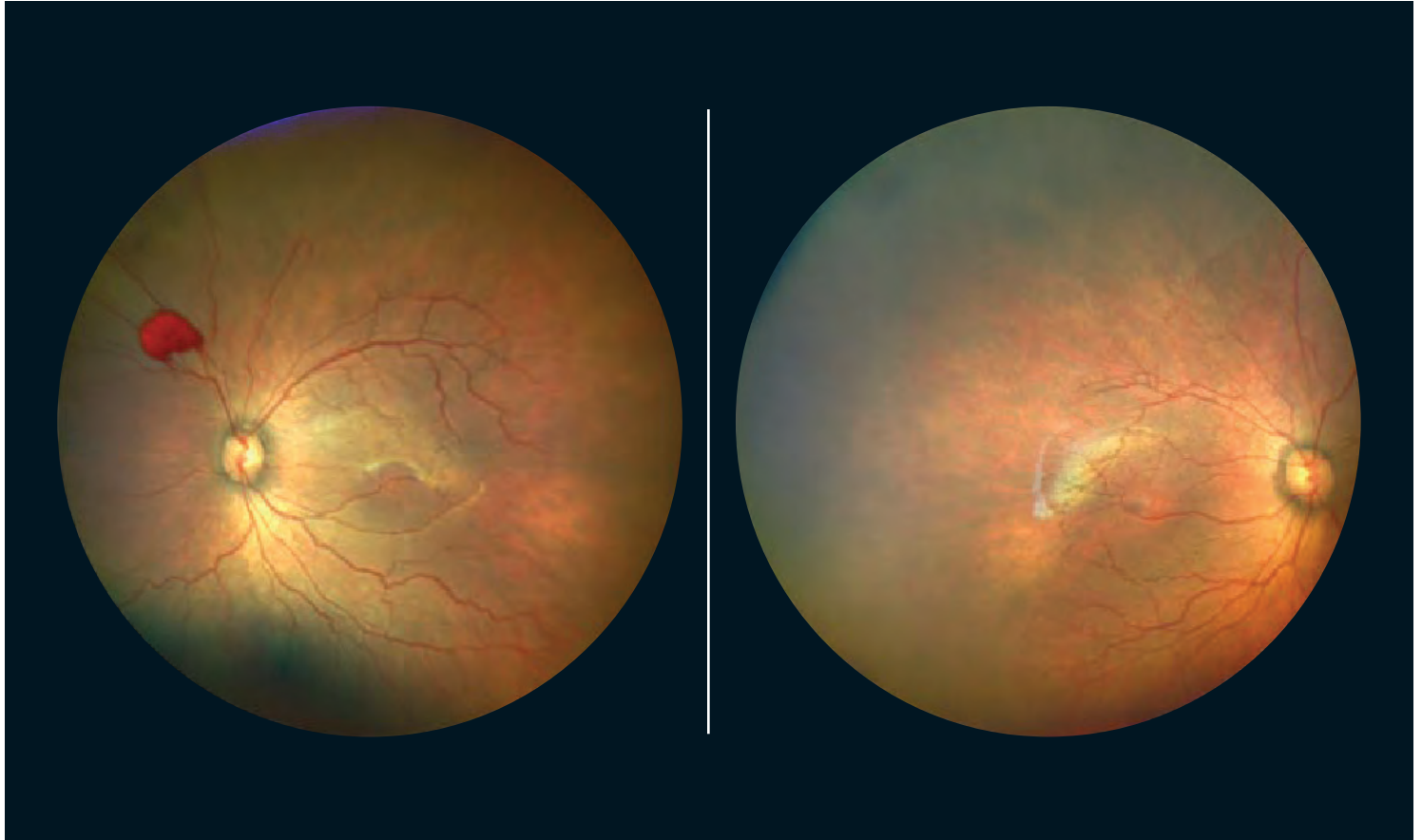
#### Description

Both eyes Aggressive Posterior Retinopathy of Prematurity (APROP) status post anti-VEGF given 1-week ago shows reduced plus disease with decreased dilatation and tortuosity of vessels. Right eye shows solitary supero-nasal preretinal bleed. The macula is just vascularized.

#### Management

Observe

At 1-month follow-up the preretinal hemorrhage in right eye had resolved. Both eyes showed significant reduction in tortuosity and the vessels were going to Zone 2 anterior now.



## APROP

### CASE 41

#### History

A preterm baby with gestational age 28 weeks, birth weight 1000 grams and post menstrual age 38 weeks.

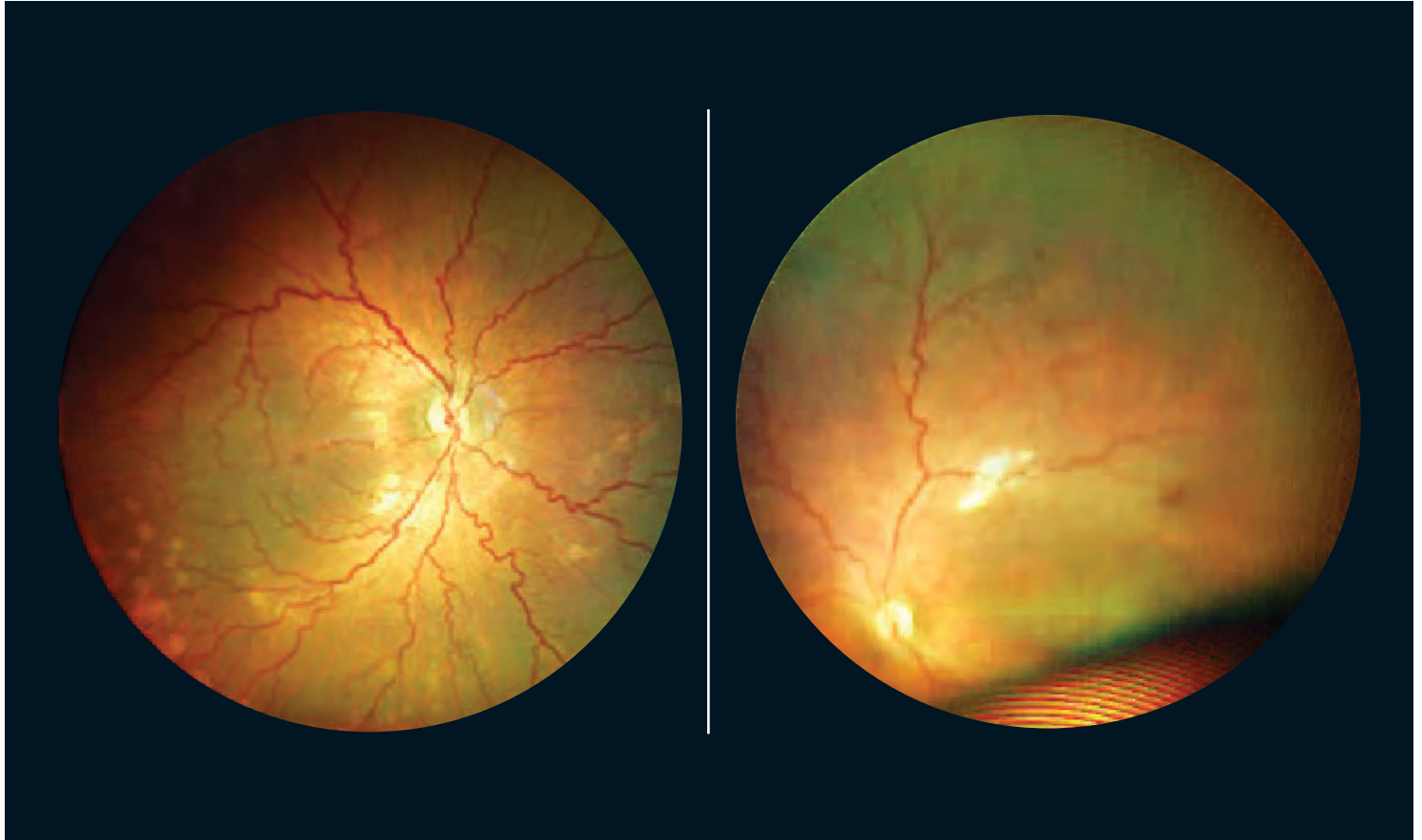
#### Description

Both eyes Aggressive Posterior Retinopathy of Prematurity (APROP) status post anti-VEGF and retinal laser. The disease is still active with plus and neovascular tufts and will need additional posterior laser in both eyes. Left eye also shows inferior lid artifacts.

#### Management

Baby received additional laser in both the eyes and during the two-week follow-up post laser the ROP was on a regressing course.





## APROP

### CASE 42

#### History

A preterm baby with gestational age 32 weeks, birth weight 1300 grams and post menstrual age 38 weeks.

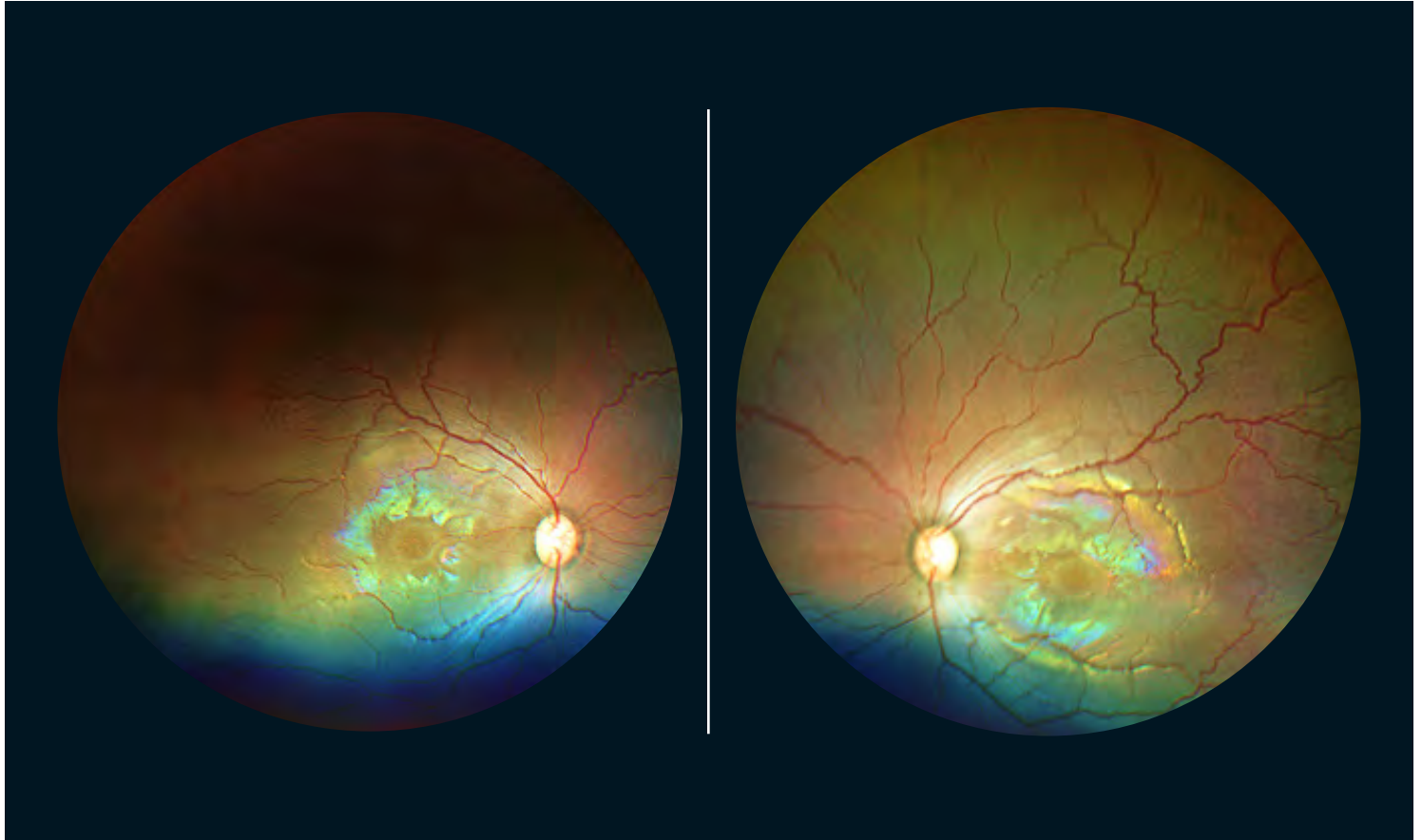
#### Description

Both eyes Hybrid Retinopathy of Prematurity (ROP) status post anti-VEGF given 2 weeks ago shows reduced plus with decreased tortuosity and dilatation of vessels and the vessels are now moving to Zone 2.

#### Management

Observe

At 1-month follow-up the vessels reached Zone 3.





# **Staged Retinopathy of Prematurity**

## SRP

### CASE 43

#### History

A preterm baby with gestational age 28 weeks, birth weight 900 grams and post menstrual age 38 weeks.

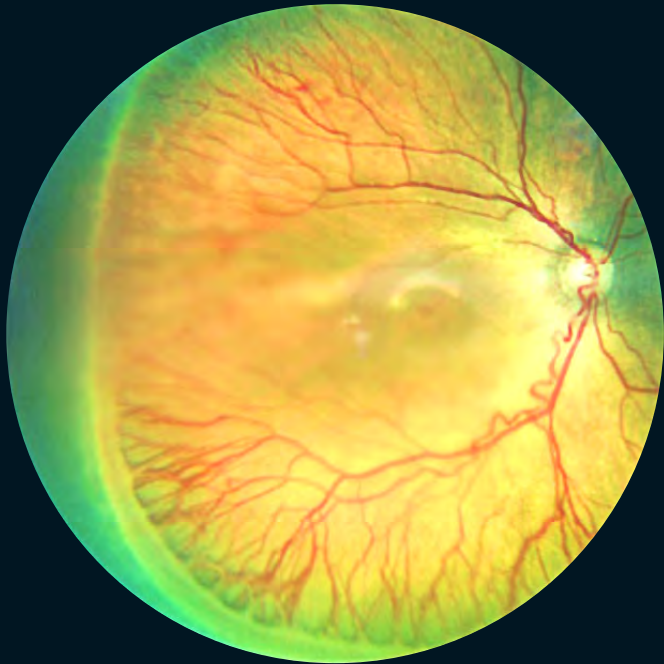
#### Description

Right eye Zone 2 Stage 3 plus Threshold Retinopathy of Prematurity (ROP) with ridge lift. Vessels are branching radially and not moving forward by dichotomous branching. The baby had similar picture in the other eye also.

The baby was advised for both eyes laser.

#### Management

At 3 weeks follow-up post laser the ROP was on a regressing course in both the eyes with flattening of ridge and reduction in vascularity and tortuosity.



## SRP

### CASE 44

#### History

A preterm baby with gestational age 28 weeks, birth weight 1000 grams and post menstrual age 40 weeks.

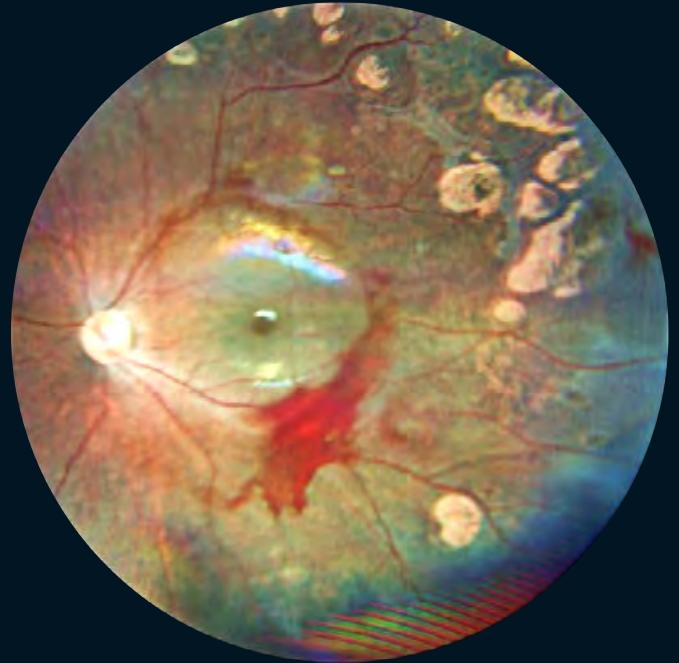
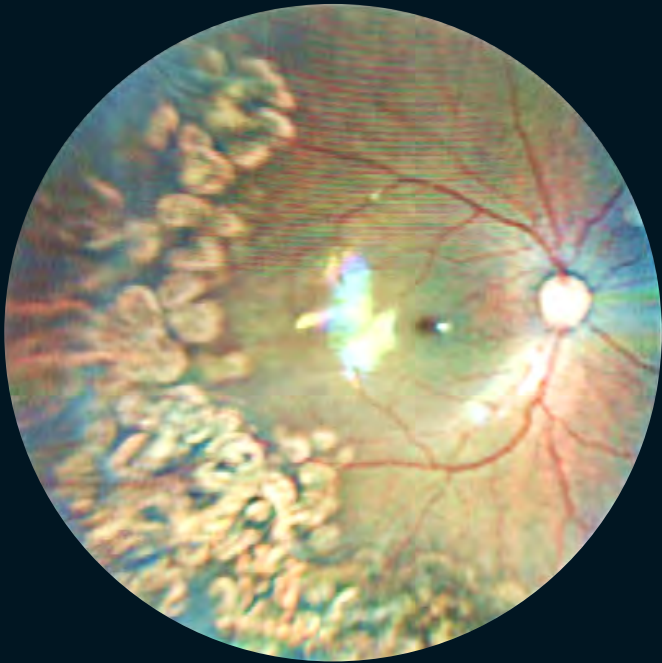
#### Description

Both eyes status post laser for Zone 2 posterior Stage 3 plus Retinopathy of Prematurity (ROP). Right eye shows confluent laser marks with regressed ROP, and left eye shows scanty laser marks with persisting preretinal hemorrhage.

#### Management

We advised additional laser to left eye. 3 weeks post laser the ROP in the left eye also regressed.





## SRP

### CASE 45

#### History

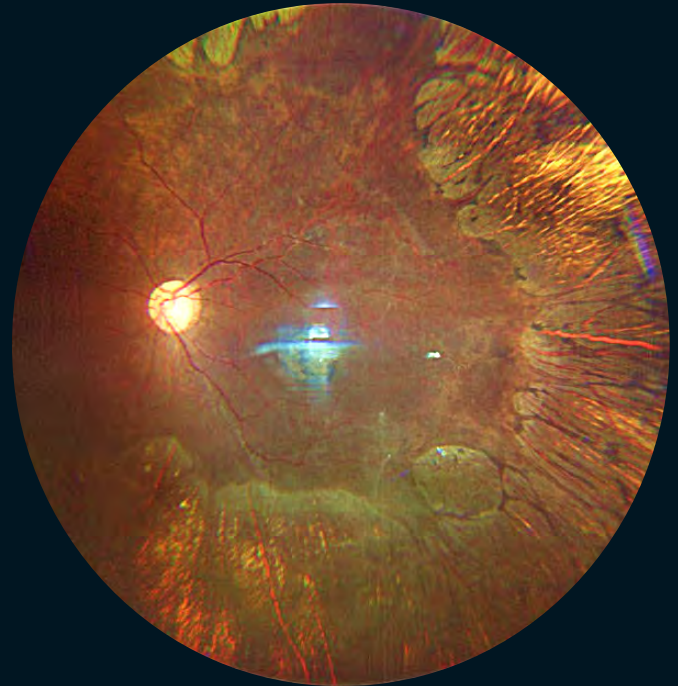
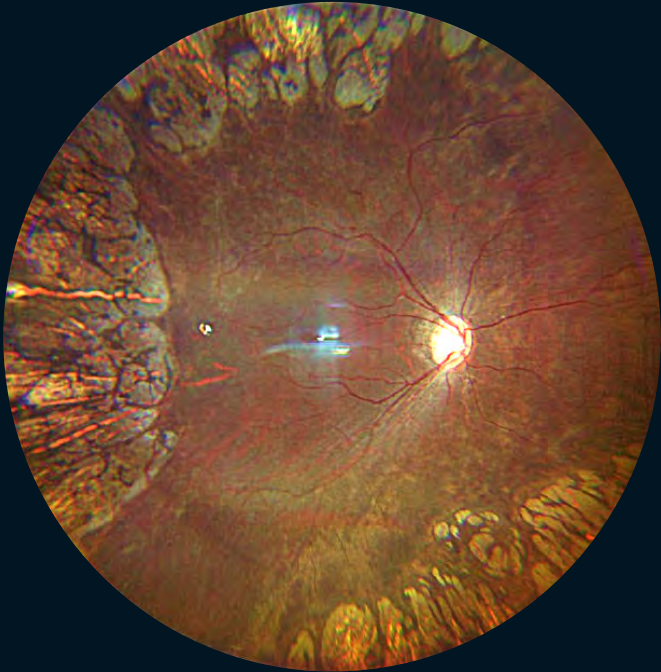
A preterm baby who had received laser treatment elsewhere came to our OPD for follow up examination. The baby was 3 years of age when this image was captured.

#### Description

Both eyes status post laser for Zone 2 posterior Stage 3 plus Retinopathy of Prematurity (ROP) showing confluent laser scars and regressed ROP.

#### Management

There was a myopic shift of minus 2 diopters noted in both the eyes which did not require any glasses at present. We advised to return for review after six months.



## SRP

### CASE 46

#### History

A preterm baby with gestational age 32 weeks, birth weight 1500 grams and post menstrual age 40 weeks.

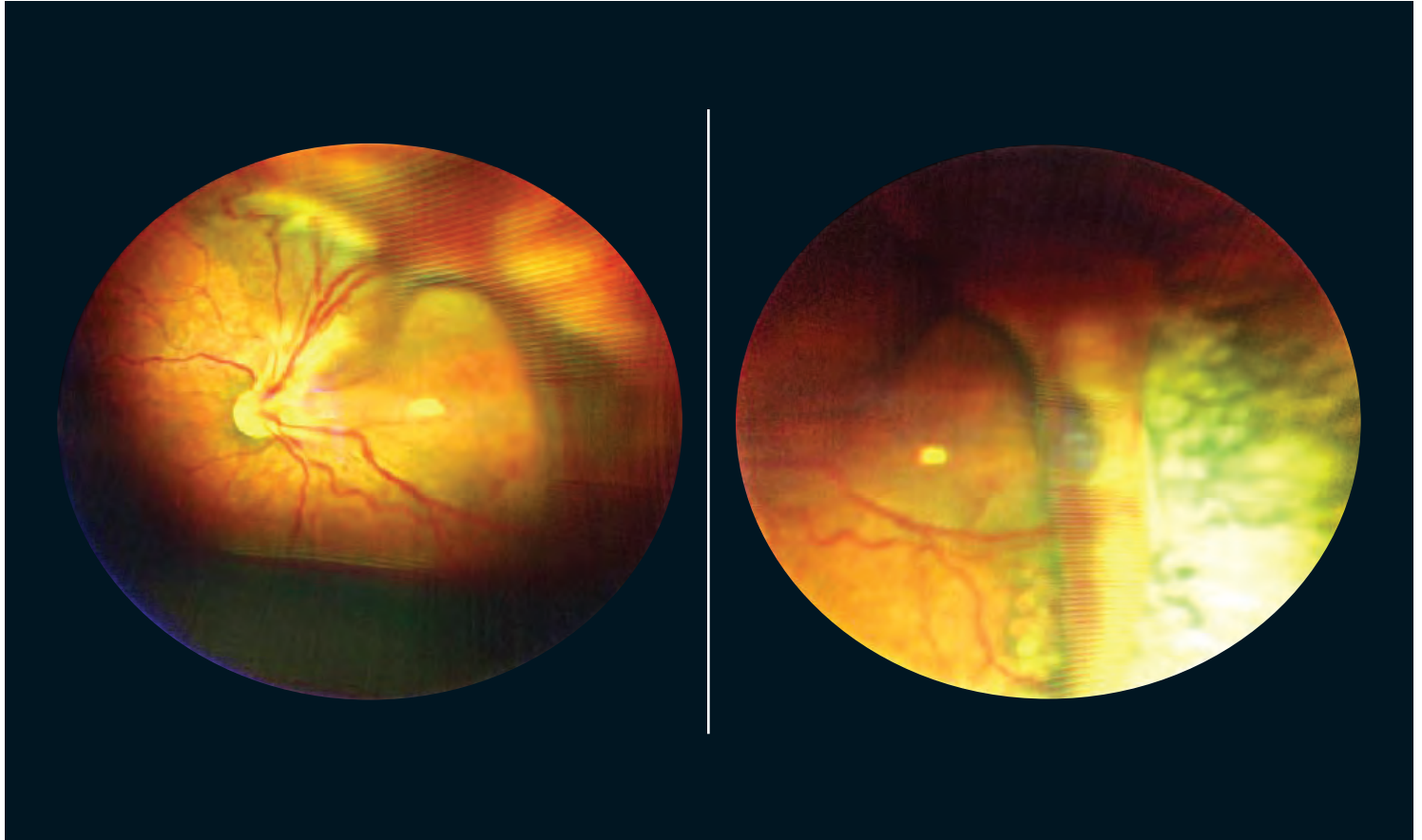
#### Description

Left eye Stage 4B Retinopathy of Prematurity (ROP) with tractional retinal detachment with disc, arcade and macular drag involving the fovea. Left eye also shows fresh laser scars done peripheral to the tractional retinal detachment just before taking the baby for vitreoretinal surgery.

#### Management

Left eye underwent Lens sparing vitrectomy (LSV) with additional endolaser and at 3-week follow-up post surgery the retina was attached and stable.

Right eye ROP had regressed with laser alone.



## SRP

### CASE 47

#### History

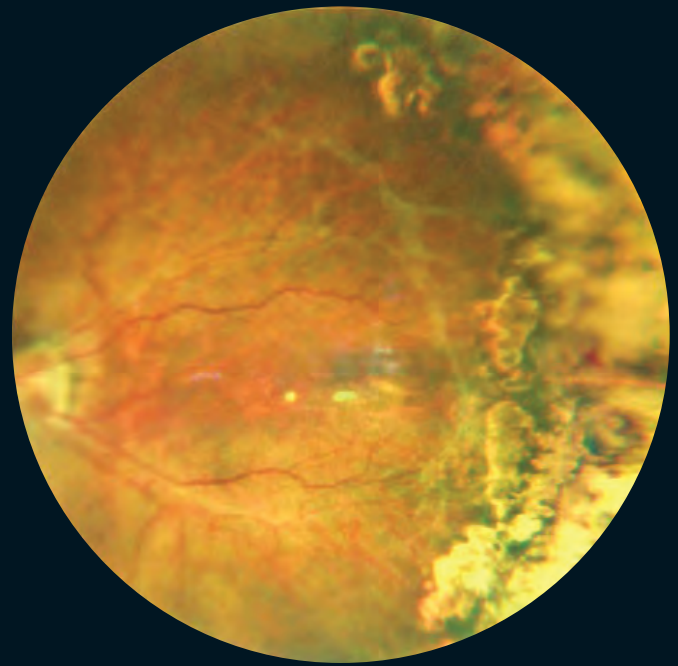
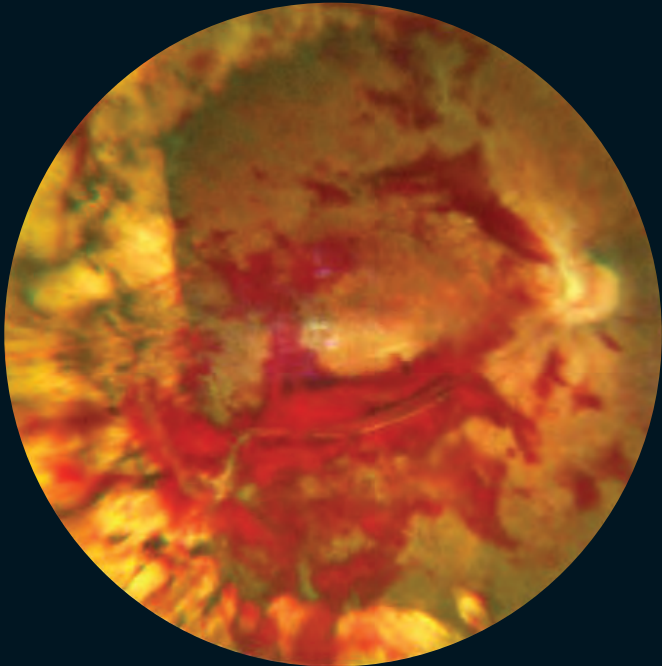
A preterm baby with gestational age 24 weeks, birth weight 770 grams and post menstrual age 35 weeks.

#### Description

Right eye Zone 2 Stage 4A Retinopathy of Prematurity (ROP) status post laser and status post pars plana vitrectomy the retina is attached with flattened ridge and presence of preretinal and vitreous hemorrhage. Left eye shows Zone 2 Stage 3 plus disease, regressed post laser.

#### Management

At 1-month follow up the hemorrhages in right eye had completely resolved. Both eyes now had a regressed ROP with stable retina.



## SRP

### CASE 48

#### History

A preterm baby with gestational age 30 weeks, birth weight 1600 grams and post menstrual age 38 weeks.

#### Description

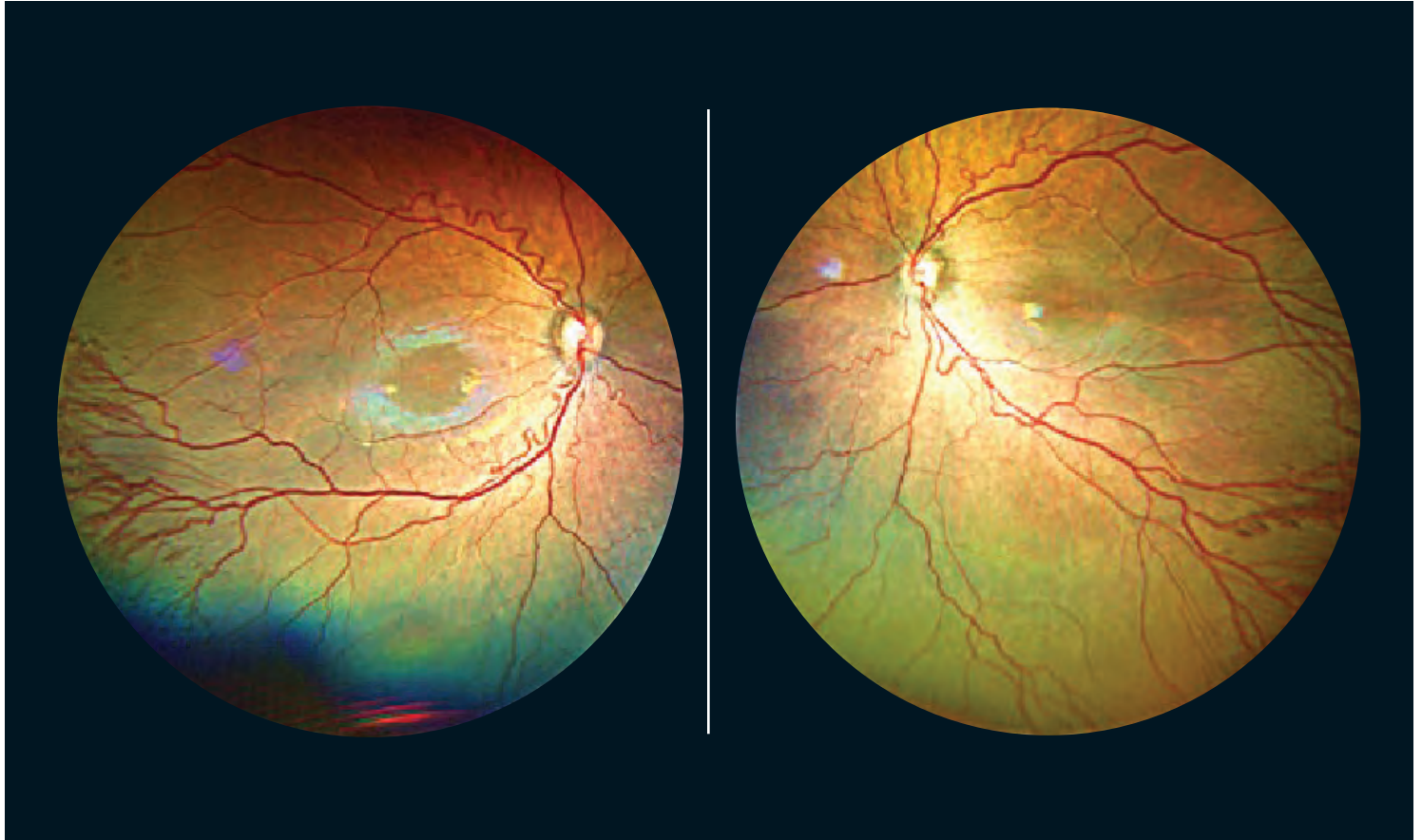
Both eyes Zone 2 Stage 3 pre-plus Retinopathy of Prematurity (ROP) with dilated and tortuous vessels which are branching radially and halting at Zone 2 more so evident in the inferotemporal quadrant in both the eyes.

#### Management

The baby was advised laser in both eyes.

3 weeks post laser, ROP completely regressed in both the eyes.





## SRP

### CASE 49

#### History

A preterm baby with gestational age 34 weeks, birth weight 2200 grams and post menstrual age 42 weeks.

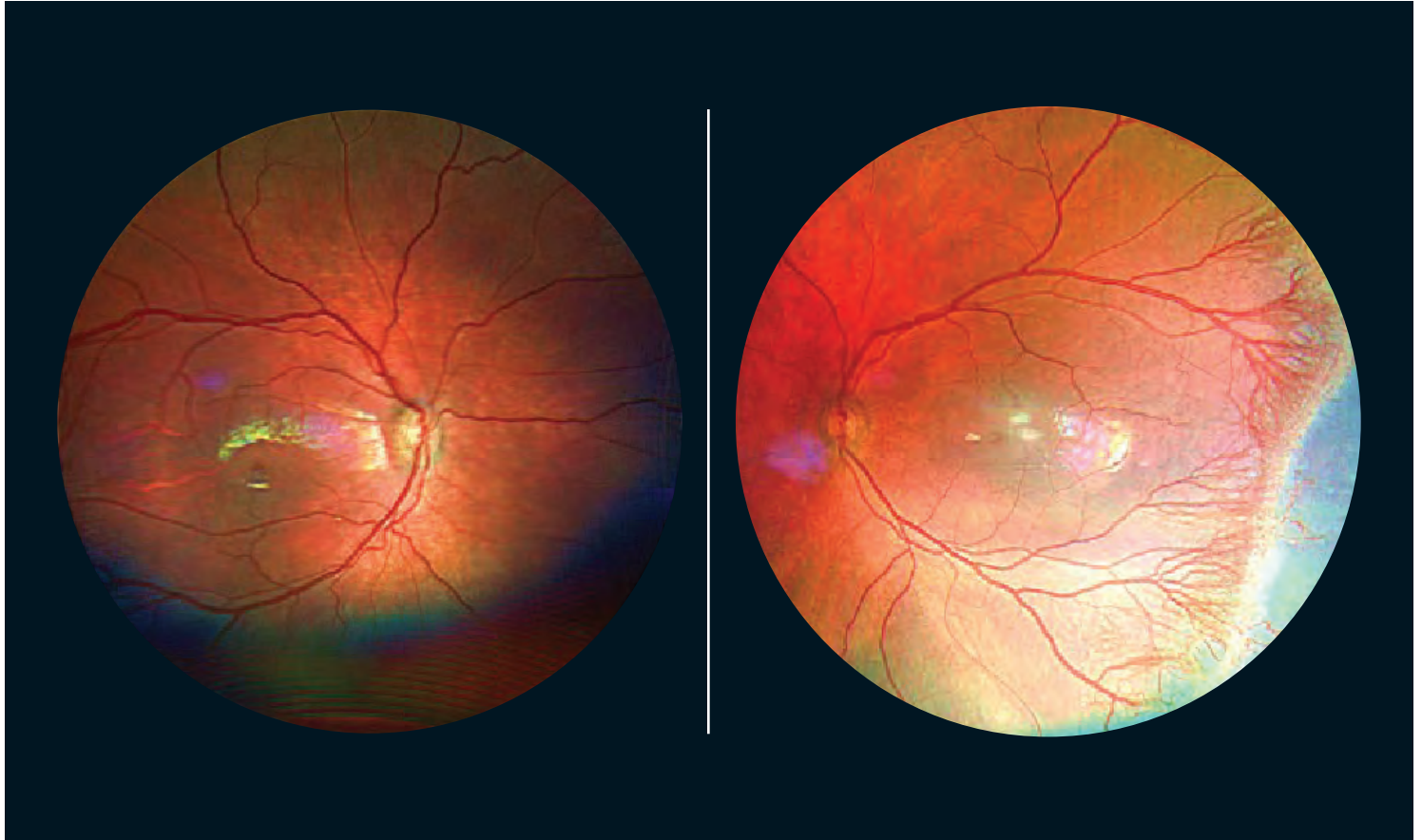
#### Description

Both eyes Zone 2 Stage 3 pre-plus Retinopathy of Prematurity (ROP) with left eye showing the fibrovascular proliferation and ridge lift. The vessels are branching radially and halting at Zone 2 more evident in temporal quadrant of left eye in the image.

#### Management

The baby was advised laser indirect ophthalmoscope in both the eyes.

Three weeks post laser ROP completely regressed in both the eyes. The ridge flattened with reduction in tortuosity of vessels in both the eyes.



## SRP

### CASE 50

#### History

A preterm baby with gestational age 28 weeks, birth weight 1250 grams and post menstrual age 38 weeks.

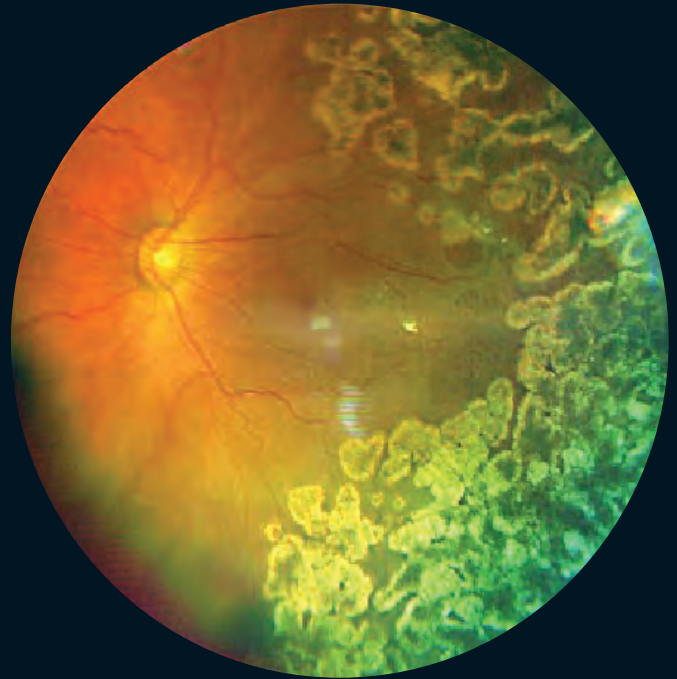
#### Description

Both eyes Zone 2 Stage 3 plus Retinopathy of Prematurity (ROP) status post laser one month ago shows regressed ROP.

Left eye shows confluent temporal laser marks.

#### Management

Additional treatment was not needed. Baby was now asked to review after 4 months to check for any refractive error like myopic shift due to laser.



## SRP

### CASE 51

#### History

A preterm baby with gestational age 28 weeks, birth weight 1500 grams and post menstrual age 40 weeks.

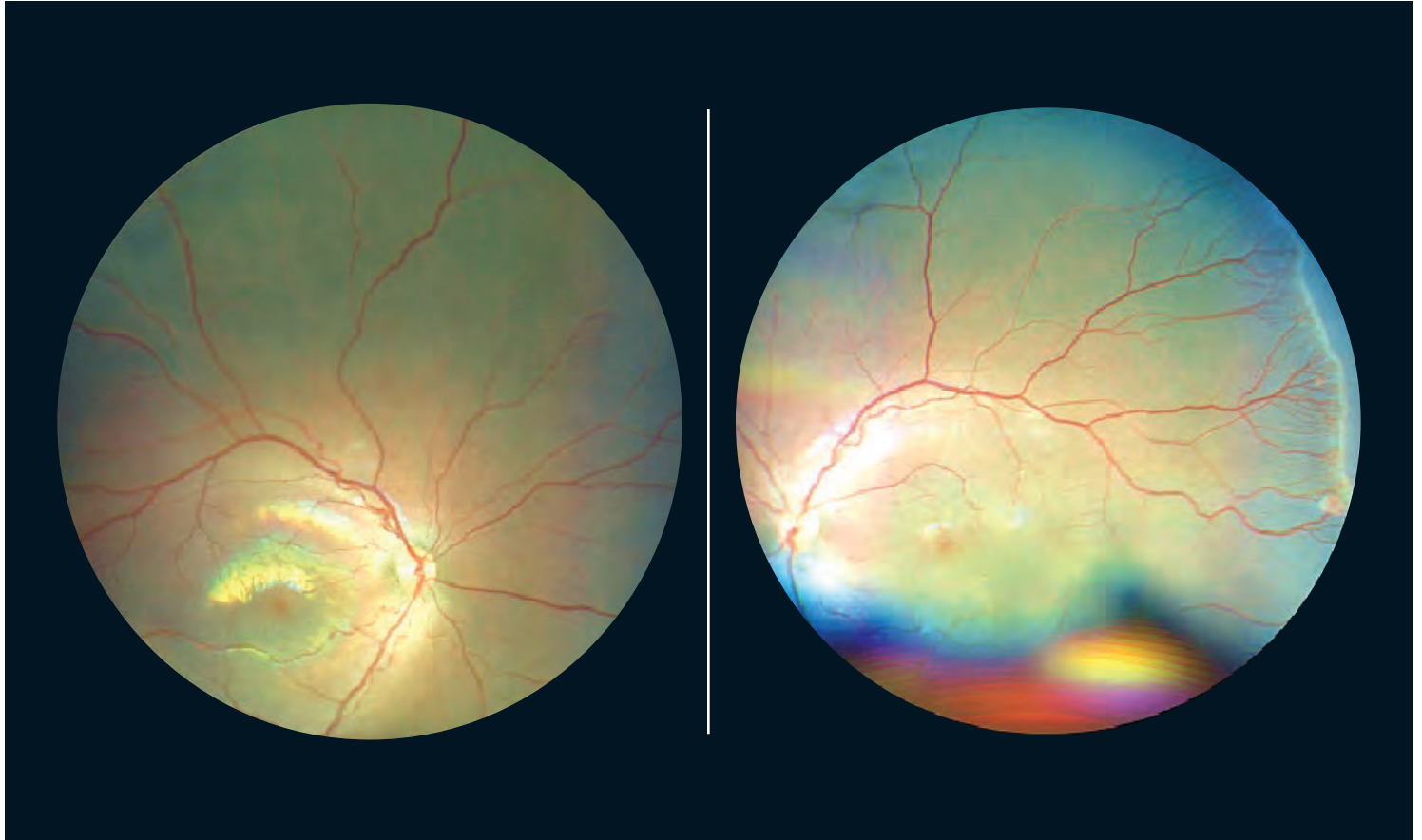
#### Description

Both eyes Zone 2 Stage 2-3 pre-plus Retinopathy of Prematurity (ROP). Left eye shows temporal ridge with radially branching and halting vessels with neovascularization at Zone 2. Left eye shows inferior lid artifact.

#### Management

The baby was advised both eyes laser on the same day.

Three weeks post laser, the ROP regressed with flattening of the ridge and reduction in vascular tortuosity in both eyes.



## SRP

### CASE 52

#### History

A preterm baby with gestational age 27 weeks, birth weight 1000 grams and post menstrual age 36 weeks.

#### Description

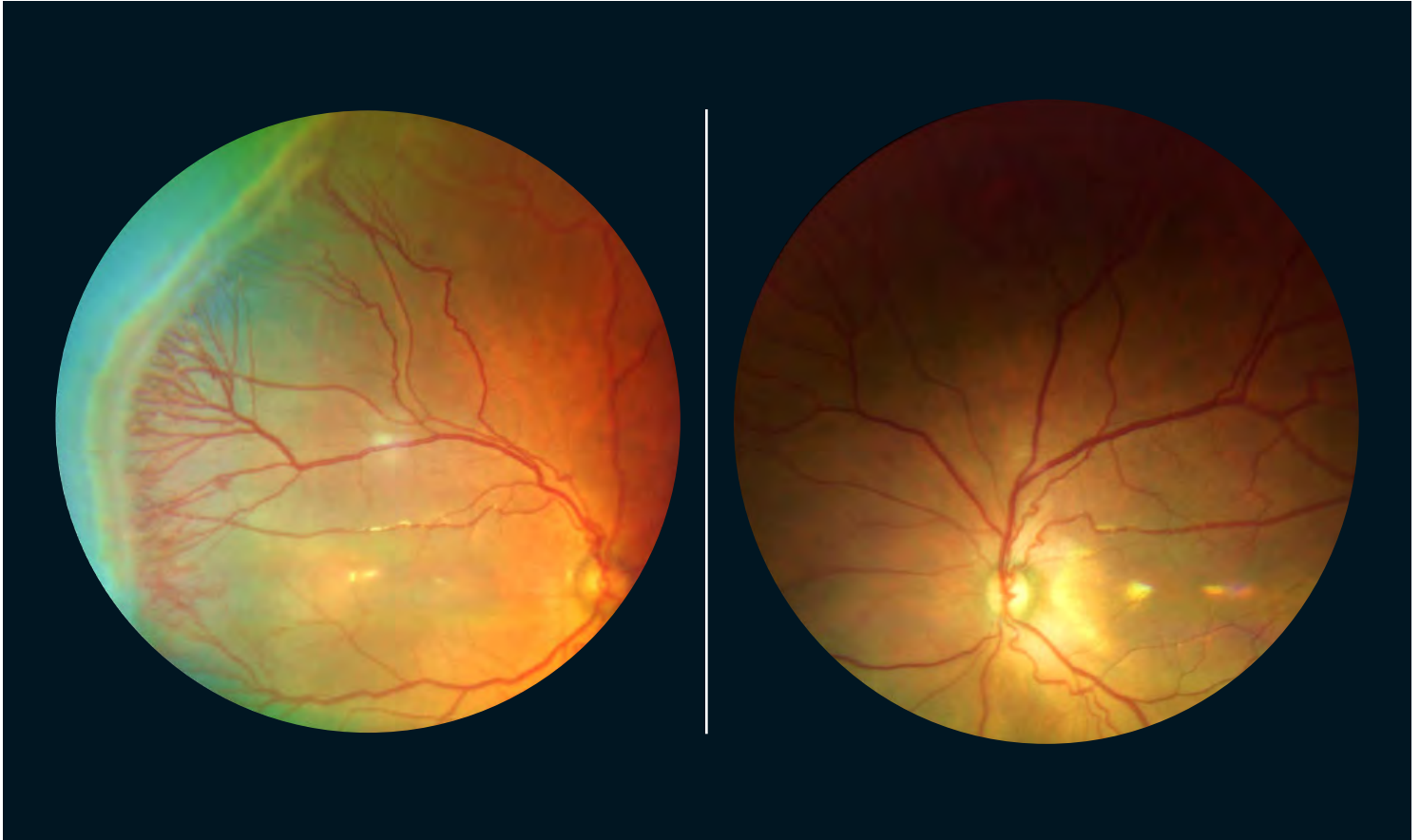
Both eyes Zone 2 Stage 2-3 pre-plus Retinopathy of Prematurity (ROP). Right eye shows threshold ROP with temporal ridge with radially branching and halting vessels with neovascularization at Zone 2.

#### Management

The baby was advised both eyes laser on the same day.

Three weeks post laser, the ROP regressed with flattening of the ridge and reduction in vascular tortuosity in both eyes.





## SRP

### CASE 53

#### History

A preterm baby with gestational age 34 weeks, birth weight 2100 grams and post menstrual age 40 weeks.

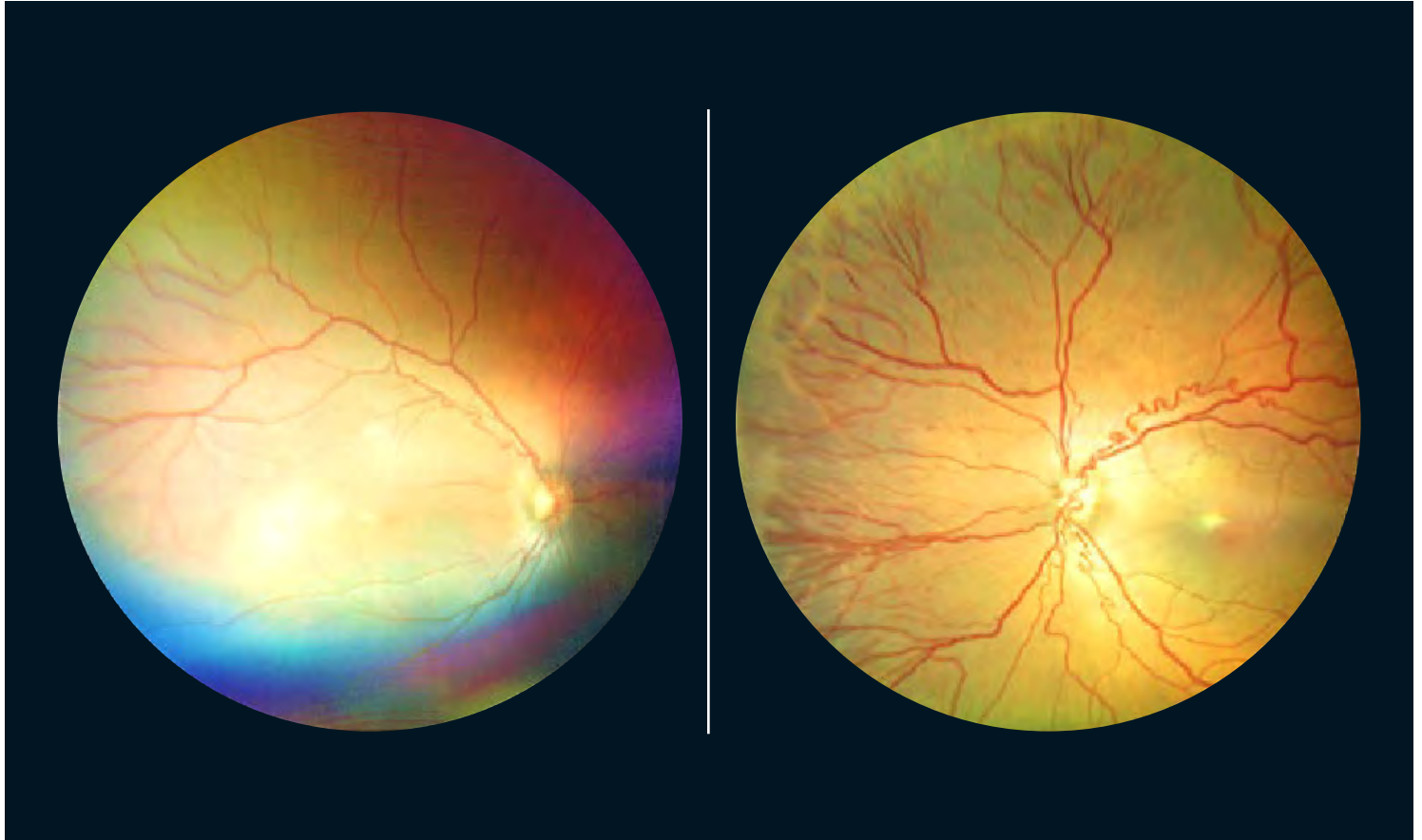
#### Description

Both eyes Zone 2 Stage 2-3 pre-plus Retinopathy of Prematurity (ROP). Left eye shows threshold ROP with nasal ridge with radially branching and halting vessels with neovascularization at Zone 2.

#### Management

The baby was advised both eyes laser indirect ophthalmoscope on the same day.

Three weeks post laser, the ROP regressed with flattening of the ridge and reduction in vascular tortuosity in both eyes.



## SRP

### CASE 54

#### History

A preterm baby with gestational age 29 weeks, birth weight 1100 grams and post menstrual age 33 weeks.

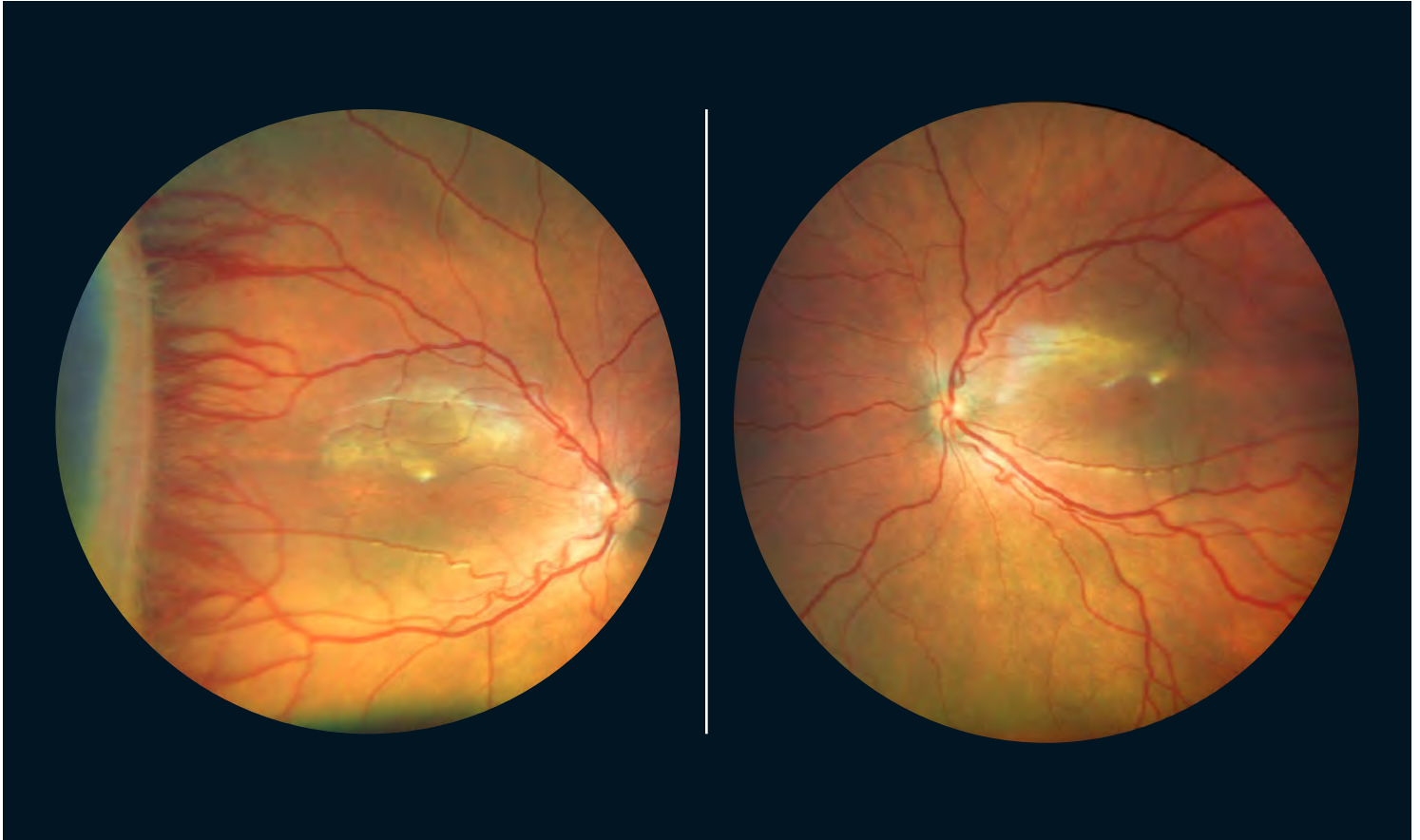
#### Description

Both eyes Zone 2 Stage 2-3 pre-plus Retinopathy of Prematurity (ROP). Right eye shows threshold ROP with temporal ridge with radially branching and halting vessels with neovascularization at Zone 2.

#### Management

The baby was advised both eyes laser indirect ophthalmoscope on the same day.

Three weeks post laser, the ROP regressed with flattening of the ridge and reduction in vascular tortuosity in both eyes.



SRP

## CASE 55

### History

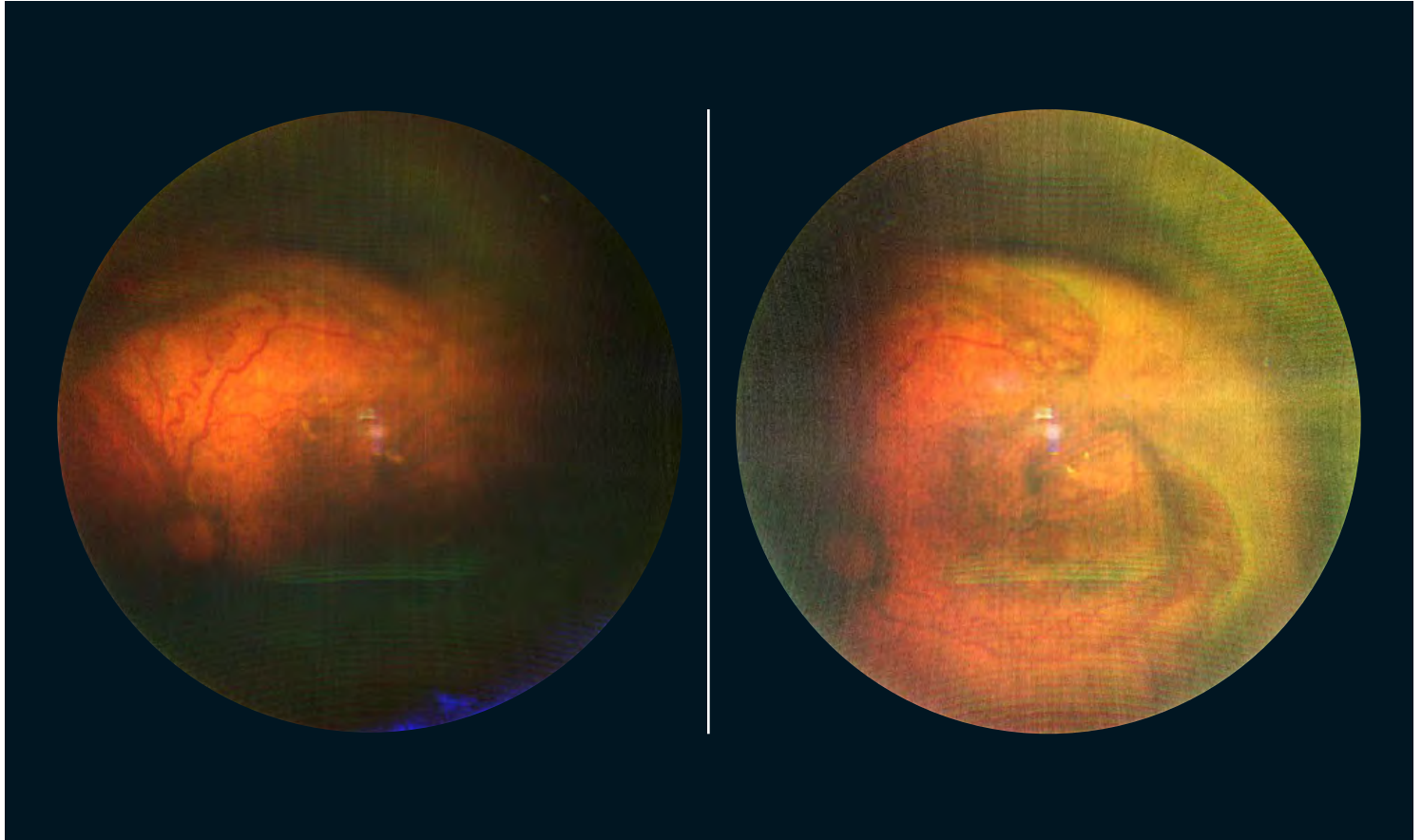
A preterm baby with gestational age 32 weeks, birth weight 1200 grams and post menstrual age 40 weeks.

### Description

Stage 4A Retinopathy of Prematurity (ROP) in the left eye with peripheral tractional retinal detachment and ridge lift not involving the macula.

### Management

Left eye was planned for Lens sparing vitrectomy with endolaser and fluid air exchange.  
Three weeks post vitreoretinal surgery the retina was attached with stable regressed ROP.  
Right eye ROP regressed with laser alone.



## SRP

### CASE 56

#### History

A preterm baby with gestational age 32 weeks, birth weight 1200 grams and post menstrual age 40 weeks.

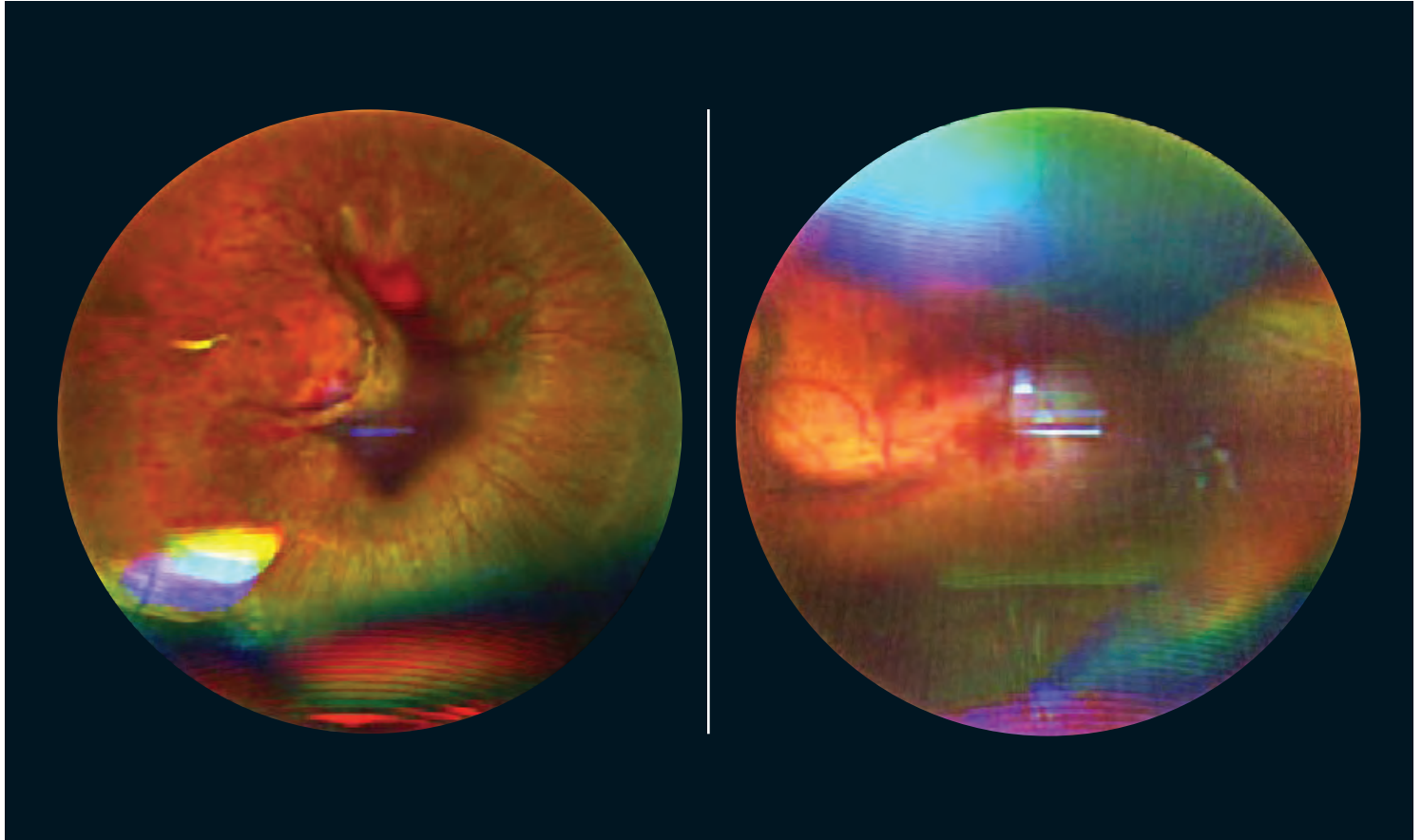
#### Description

Both eyes Stage 4B Retinopathy of Prematurity (ROP) with tractional retinal detachment involving the macula.

#### Management

Lens sparing vitrectomy, endolaser and fluid air exchange was planned for both eyes. Three weeks post vitreoretinal surgery the retina was attached in both the eyes with regressed ROP.





## SRP

### CASE 57

#### History

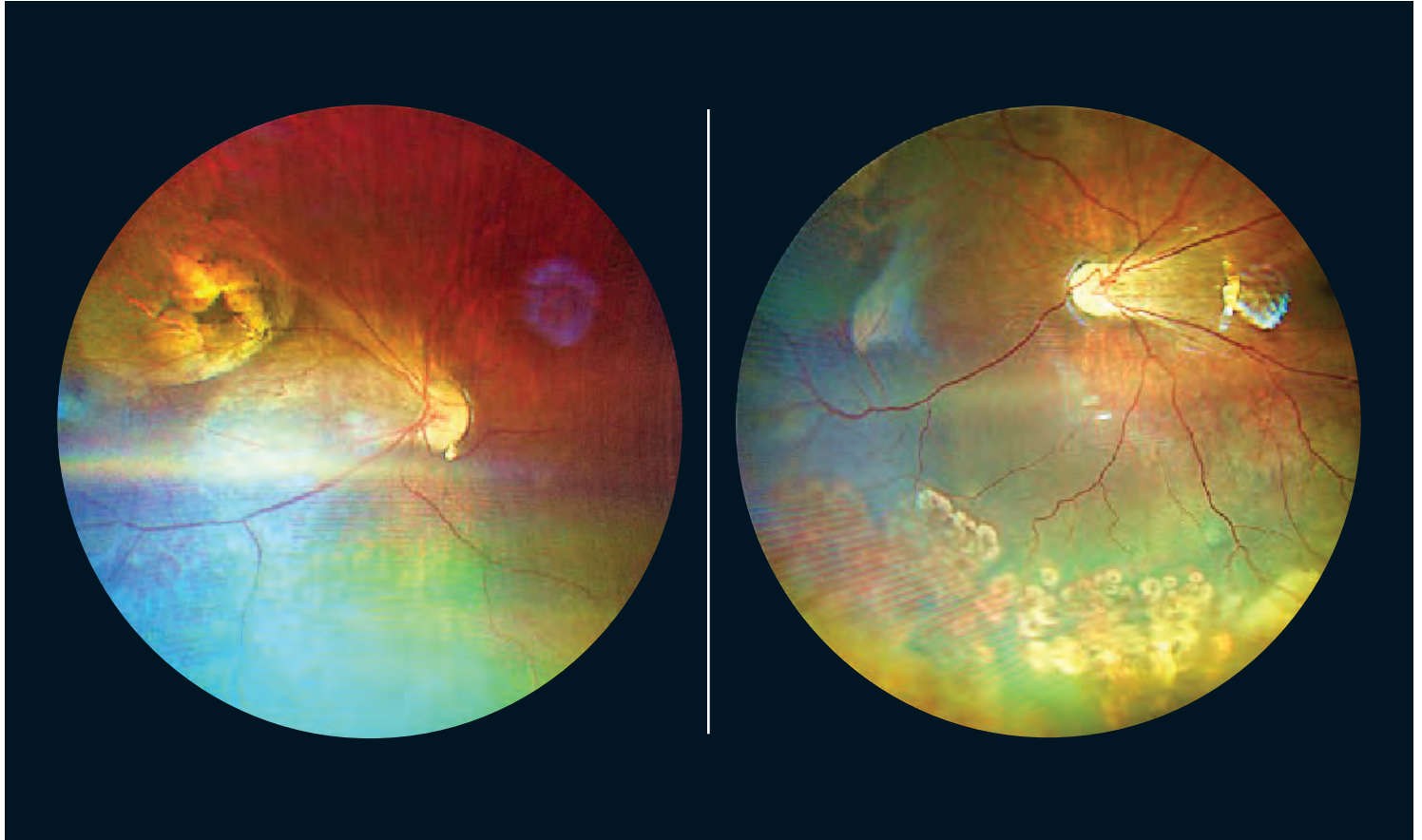
A preterm baby with gestational age 28 weeks, birth weight 1800 grams and at present the baby is 6 months old.

#### Description

Both eyes Stage 4A Retinopathy of Prematurity (ROP) with Tractional Retinal Detachment operated for lens sparing vitrectomy 5 months ago returned with disc and arcade drag; ROP had regressed, and retina was stable showing laser scars.

#### Management

Since both eyes had stable retina, the baby was asked to review after 4 months for repeat refraction and fundus examination.



## SRP

### CASE 58

#### History

A preterm baby with gestational age 32 weeks, birth weight 1300 grams and at presentation the baby was 5 months old.

#### Description

Left eye Stage 4A Retinopathy of Prematurity (ROP) status post belt buckle and laser.

Left eye now shows regressed ROP with stable attached retina; buckle indent is seen temporally.

#### Management

Since both eyes had stable retina, right eye status post laser alone and left eye status post vitreoretinal surgery, the baby was asked to review after 4 months for repeat refraction and fundus examination.





# Other Neonatal Retinal Diseases

- Atypical Presentation of ROP
- Neonatal Retinal Infections
- Familial Exudative Vitreoretinopathy (FEVR)

## ONRD

### CASE 59

#### History

Gestational age 34 weeks, birth weight 1500 grams and post menstrual age 38 weeks.

#### Description

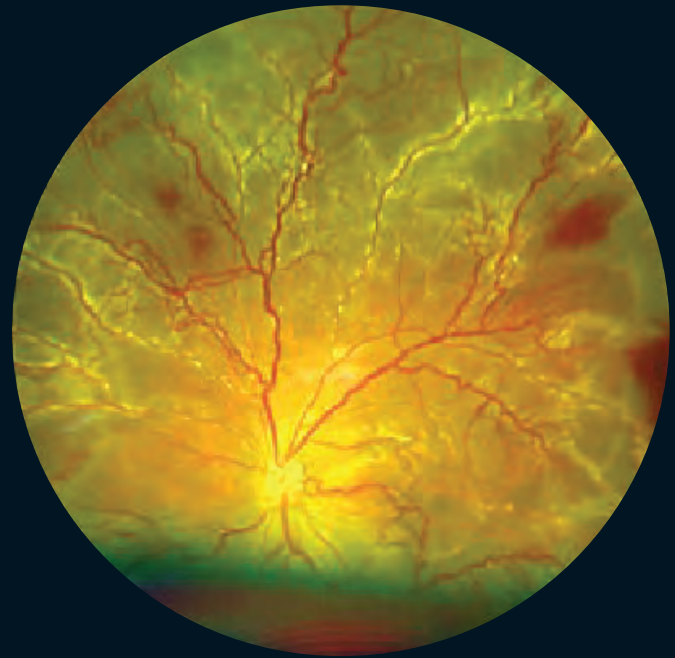
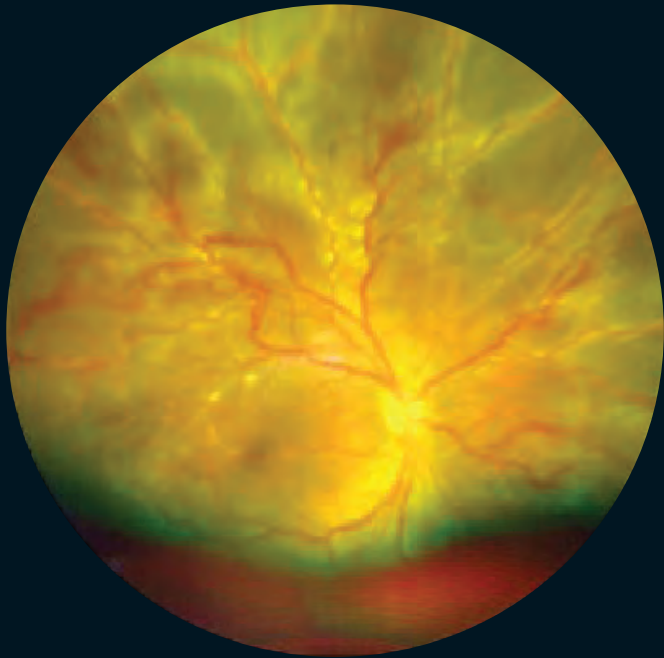
Both eyes Aggressive Posterior Retinopathy of Prematurity (APROP) with looping, shunting of vessels and hemorrhages. Both eyes showed suspected vasculitis with exudation like picture and was asked for TORCH infection titers on suspicion.

#### Management

TORCH infection titers did not reveal anything significant.

Baby was advised intravitreal anti-VEGF (anti-Vascular Endothelial Growth Factor) injection in both the eyes on the same day. Post injection follow up at 1-week showed reduced plus disease with decreasing tortuosity of vessels and reduced vasculitis features.





## ONRD

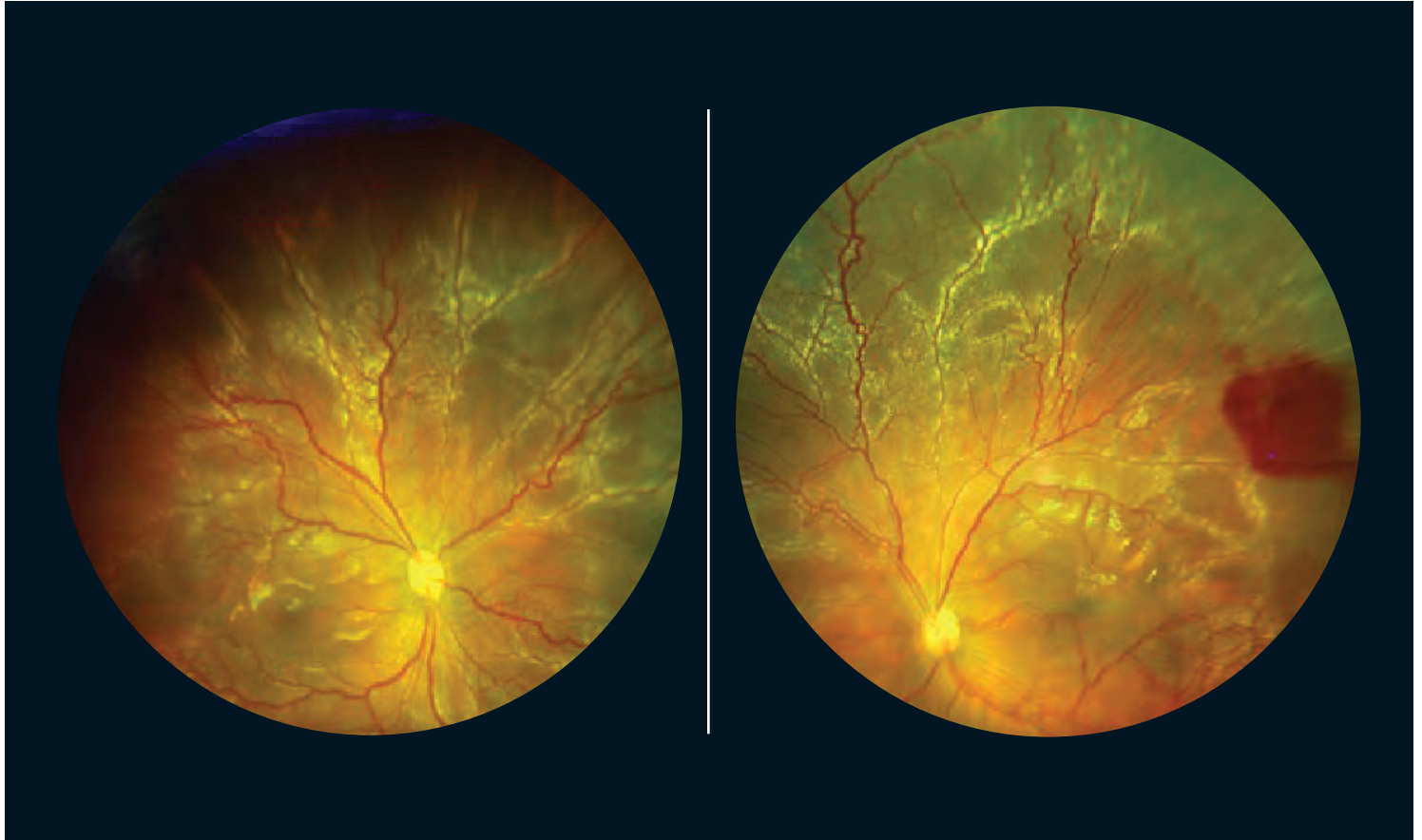
### CASE 59: Continued follow-up at 1-week

#### Description

Both eyes Aggressive Posterior Retinopathy of Prematurity (APROP) status post intravitreal anti-VEGF given 1-week back shows reduced plus disease with decreased vessel dilatation and tortuosity and reduced vasculitis features.

#### Management

Post injection follow up at 1-week showed reduced plus disease, decreasing tortuosity of vessels, and reduced vasculitis. At 3 weeks follow-up the plus disease and vasculitis features reduced further, and the vessels began to advance to Zone 2 anterior.



**History**

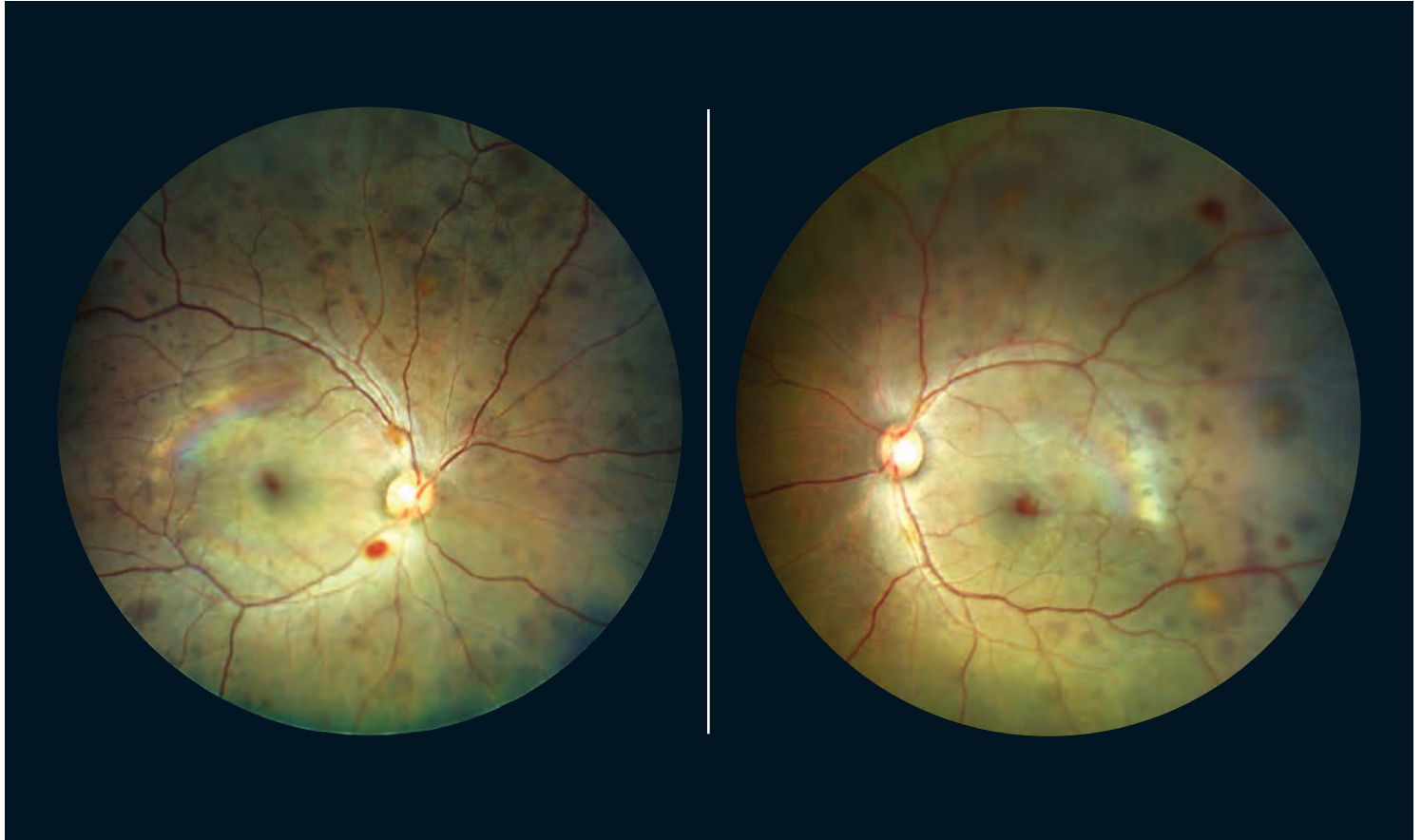
Parents of a 4-month-old baby complained that the child was not recognizing objects and people that it was recognizing before.

**Description**

Both eyes were suspected to having TORCH infection. The fundus showed Retinal Pigmented Epithelium (RPE) changes with darkly pigmented fundus and few intraretinal hemorrhages.

**Management**

The baby was advised for blood titers to rule out TORCH infection.  
However, the prognosis was guarded due to extensive RPE changes.



CASE 61

History

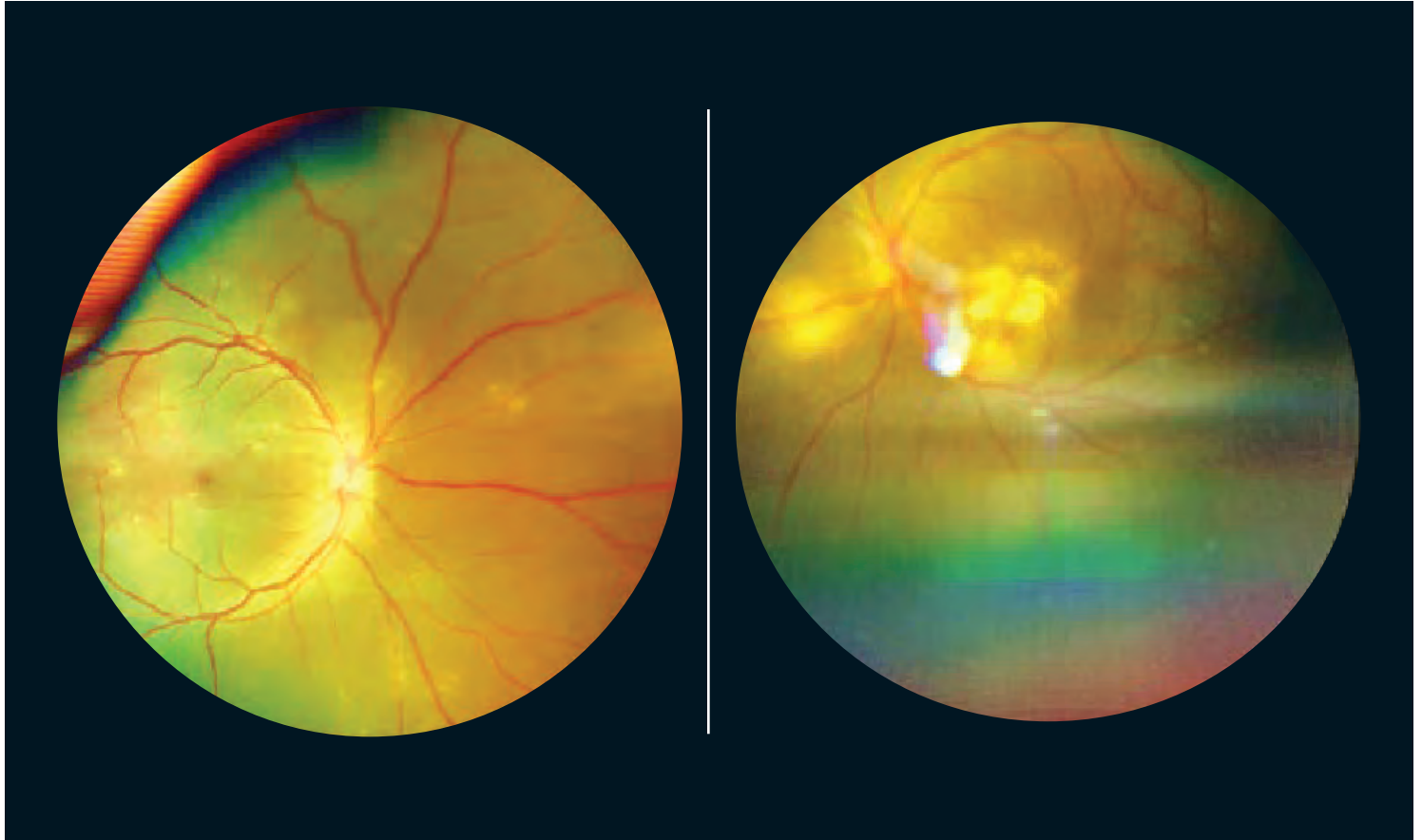
A preterm baby with gestational age 35 weeks, birth weight 2600 grams and post menstrual age of 40 weeks.

Description

Both eyes multiple chorioretinal yellowish white lesions; the left eye had large macular lesion. TORCH titers showed raised IgG and IgM for toxoplasmosis indicating, congenital toxoplasmosis.

Management

Systemic treatment was started by pediatrician and left eye received intravitreal clindamycin injection.



## ONRD

### CASE 61: Continued follow-up at 2 weeks

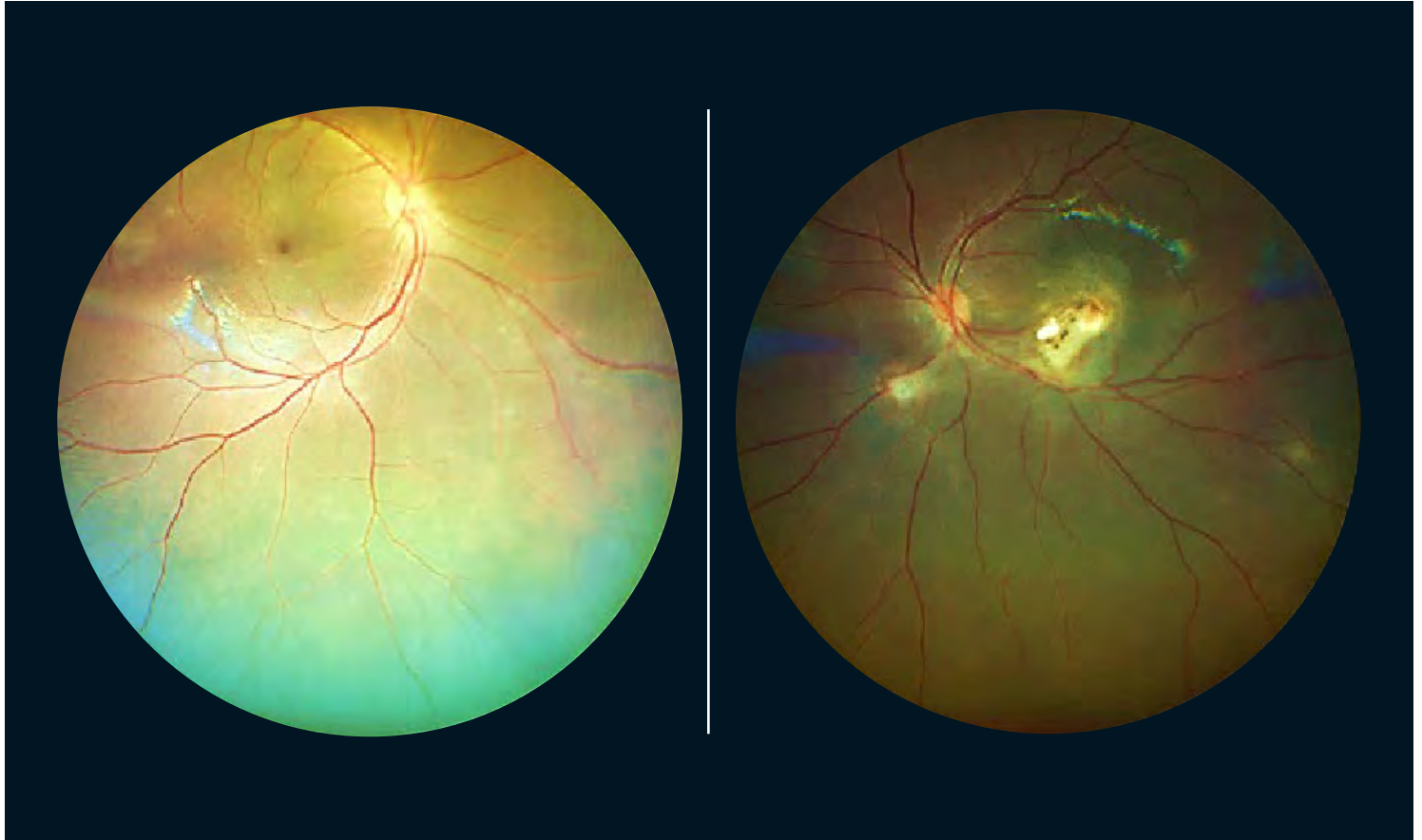
#### Description

Both eyes resolved chorioretinal toxoplasmosis lesion post systemic treatment and status post clindamycin intravitreal in left eye showing resolved macular lesion with scarring.

#### Management

Systemic treatment was continued by pediatrician for 6 weeks and the baby was reviewed every week for fundus examination.





## ONRD

### CASE 62

#### History

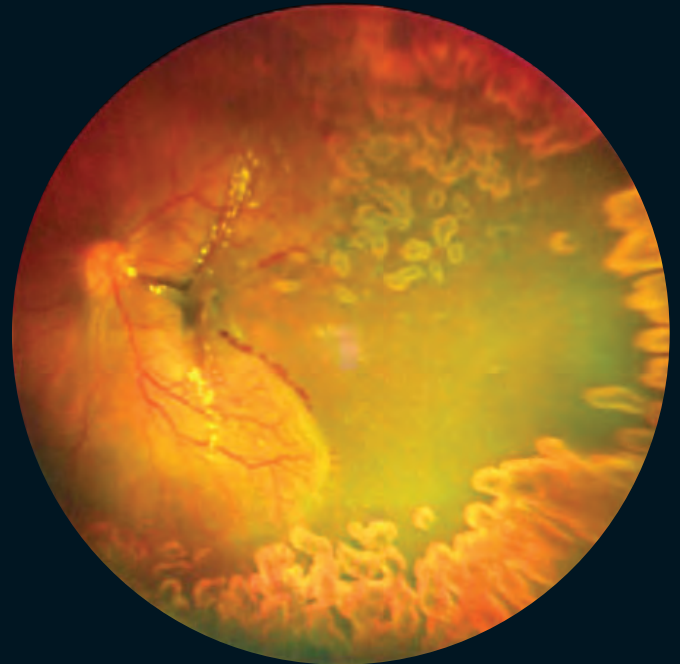
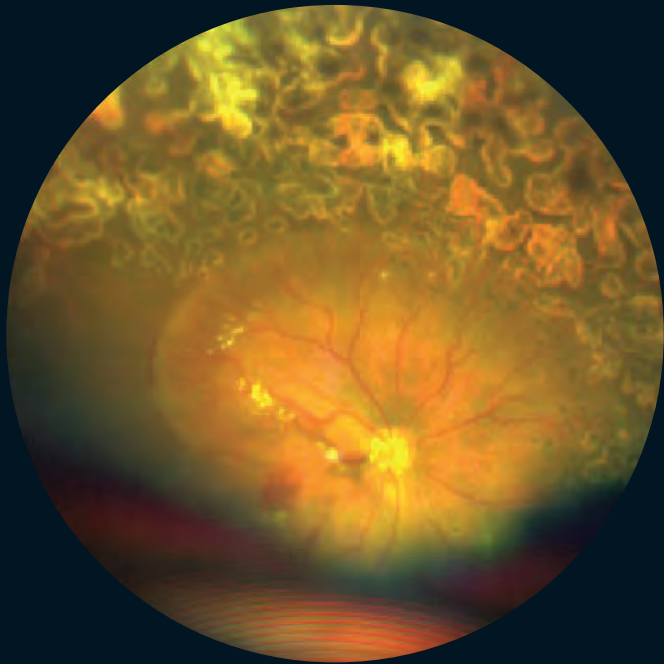
A late preterm baby with gestational age 36 weeks, birth weight 2000 grams and post menstrual age of 40 weeks.

#### Description

Both eyes Familial Exudative Vitreoretinopathy (FEVR) with dilated and tortuous vessels in Zone 1 and showing extensive areas of avascular retina. Both eyes status post laser to avascular retina. Right eye shows inferior eye lid artifact.

#### Management

Baby was closely monitored weekly for 1-month till the retina became stable post laser.



## ONRD

### CASE 63

#### History

A term baby with birth weight 2000 grams and post menstrual age of 52 weeks.

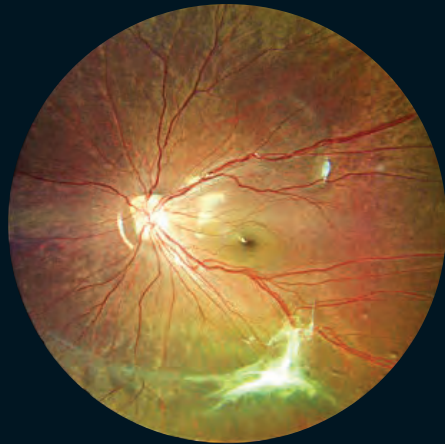
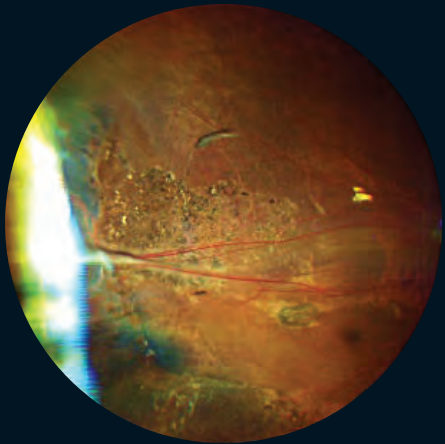
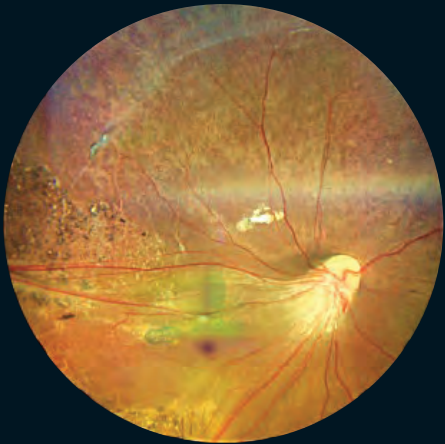
#### Description

Both eyes Familial Exudative Vitreoretinopathy (FEVR) with disc and arcade drag with peripheral avascular retina with traction which has largely quieted and stabilized now.

#### Management

Observe now

Review after 4 months for repeat refraction and fundus examination was advised.



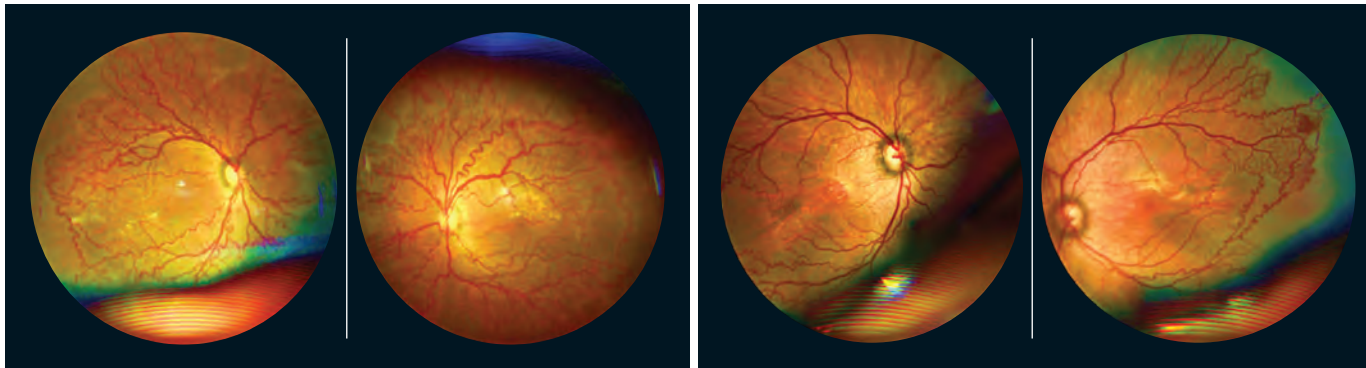


# Artifacts

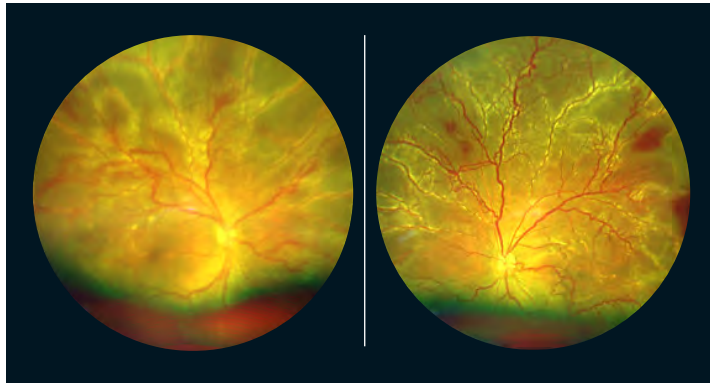
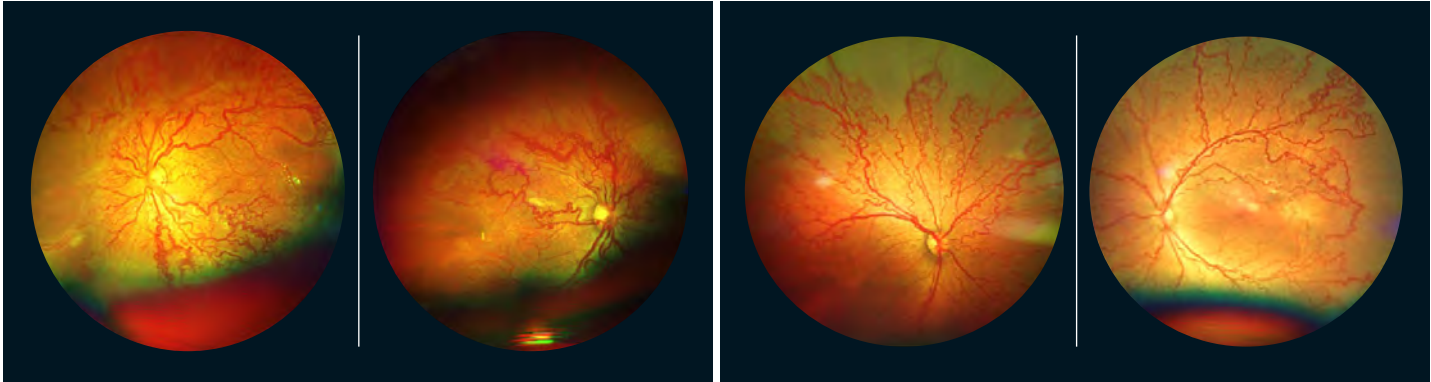
## Eyelid artifacts

**Eye lid artifacts are comparatively less in ZEISS CLARUS but still a possibility due to the following factors**

- a.) Technician dependent.
- b.) Large babies and babies more than 3 months of age who are difficult to be held in flying baby position.
- c.) Widefield nature of ZEISS CLARUS which captures 133 degrees of field of view in a single frame.







## Contact imaging systems

- Can pose a risk of eye infection, especially conjunctivitis, due to corneal apposition of the probe
- It requires a lot of skill and training of eye care professionals to capture these images
- Cannot be used in eyes immediate post anti-Vascular Endothelial Growth Factor (anti-VEGF) injection or post vitrectomy
- Slower rate of image acquisition
- Needs accurate focussing and images at times can be difficult to interpret in darker pigmented fundus
- Portable nature makes it handy in sick babies admitted in neonatal intensive care unit
- Retina facility needs a separate machine only for babies and cannot be used in adults

## Non-Contact imaging systems

- No risk of eye infection
- Needs less training and the machine is operator friendly
- Can be used due to its non-contact nature
- Faster rate of image acquisition
- Eyelash and lid artifacts are common
- More useful in stable new-born in OPD settings
- Same equipment can be used for all age groups

## Ultra-widefield imaging - ZEISS CLARUS 700

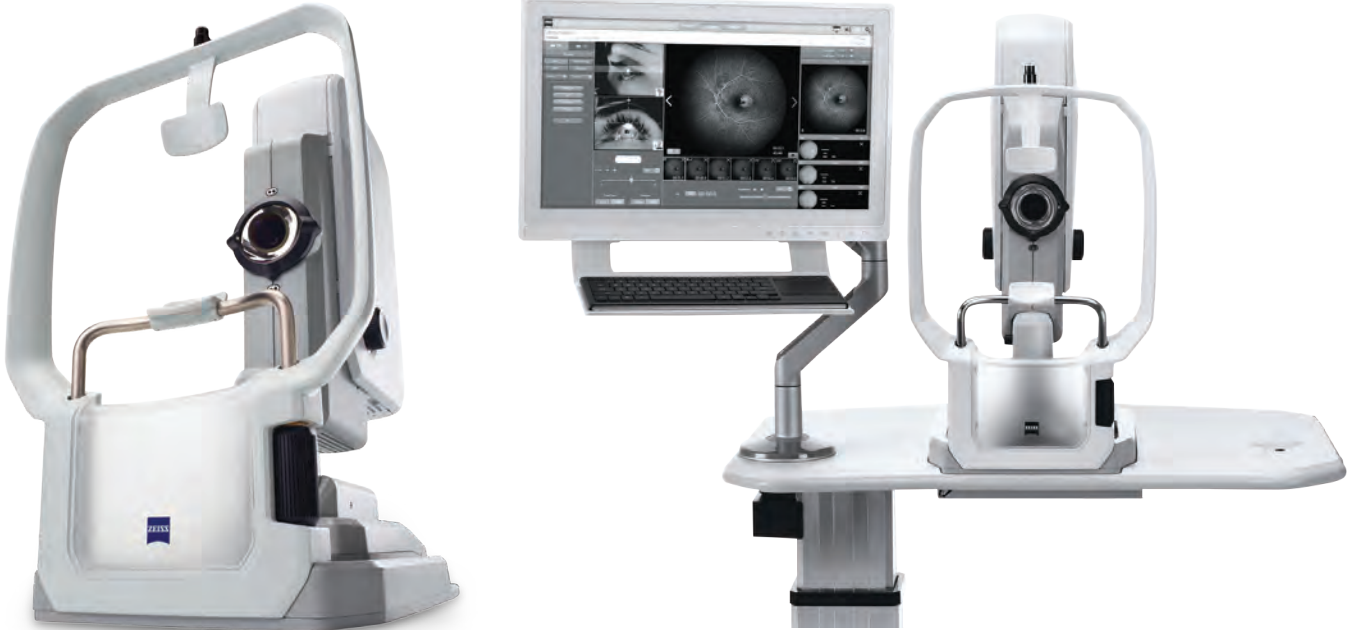
- True colour  
(With Red, Green and Blue channel separation)
- Widefield (one image) - 133 degrees
- Ultra-widefield (two images) - 200 degrees
- Montage (up to six images) up to 267 degrees
- Minimum pupil diameter 2.5mm
- Working distance 25mm
- Image acquisition speed <0.2 seconds (faster)
- True colour reflectance imaging could help in more accurate diagnosis and grading the severity of ROP

## Summary:

ZEISS CLARUS non-contact widefield imaging system can capture high resolution and true colour images helping in more accurate diagnosis and grading of the severity of ROP. This helps in better explaining the ROP features to medical trainees and also in counselling the parents of the babies. Same machine used to capture adult retinal images can be used without any modification for imaging of ROP.

For the very first time we have showed that ZEISS CLARUS can be safely and effectively used to capture ROP.

NC-WFI was performed using the ZEISS CLARUS 700 high resolution true colour reflectance imaging (Carl Zeiss Meditec, Dublin, CA).



# ACKNOWLEDGEMENTS

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## Scientific Paper of this Atlas

Belenje A, Reddy RU, Agarwal K, Parmeswarappa DC, Jalali S.  
Non-contact widefield neonatal retinal imaging for Retinopathy of Prematurity (ROP) using the ZEISS Clarus 700 high resolution true colour reflectance imaging.

Eye (Lond). 2022 Oct 4. doi: 10.1038/s41433-022-02273-2.



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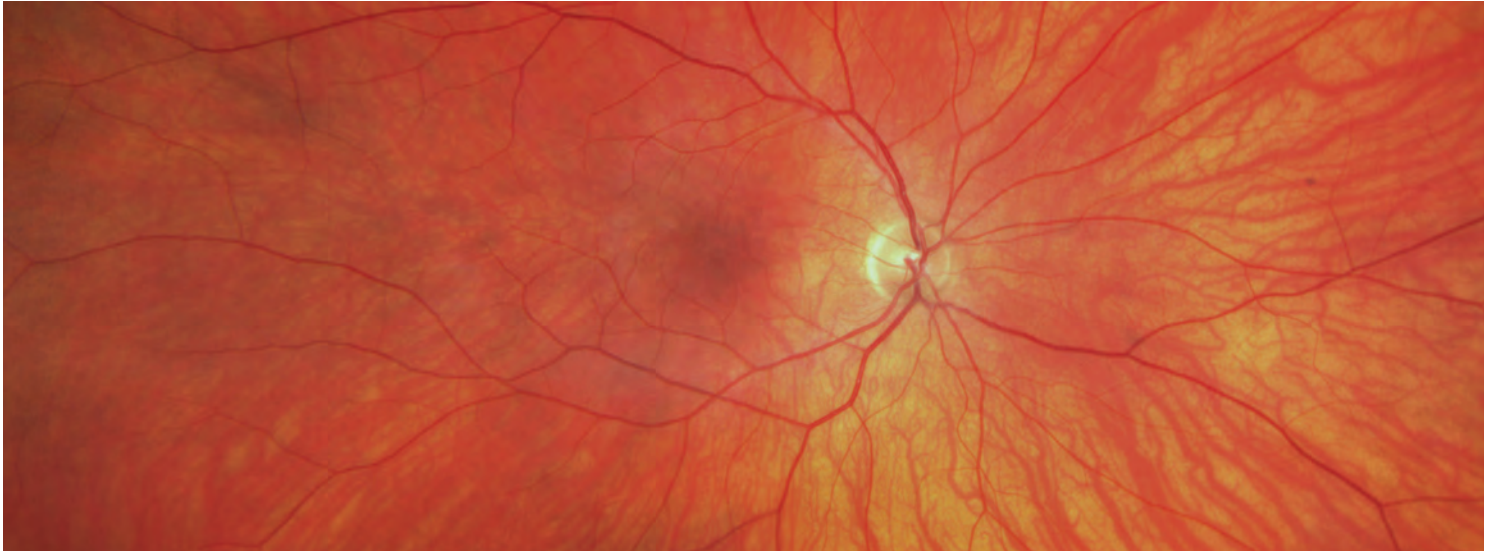
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# Expanding insights with ultra-wide imaging.

## Fluorescein Angiography



### **ZEISS CLARUS 700**

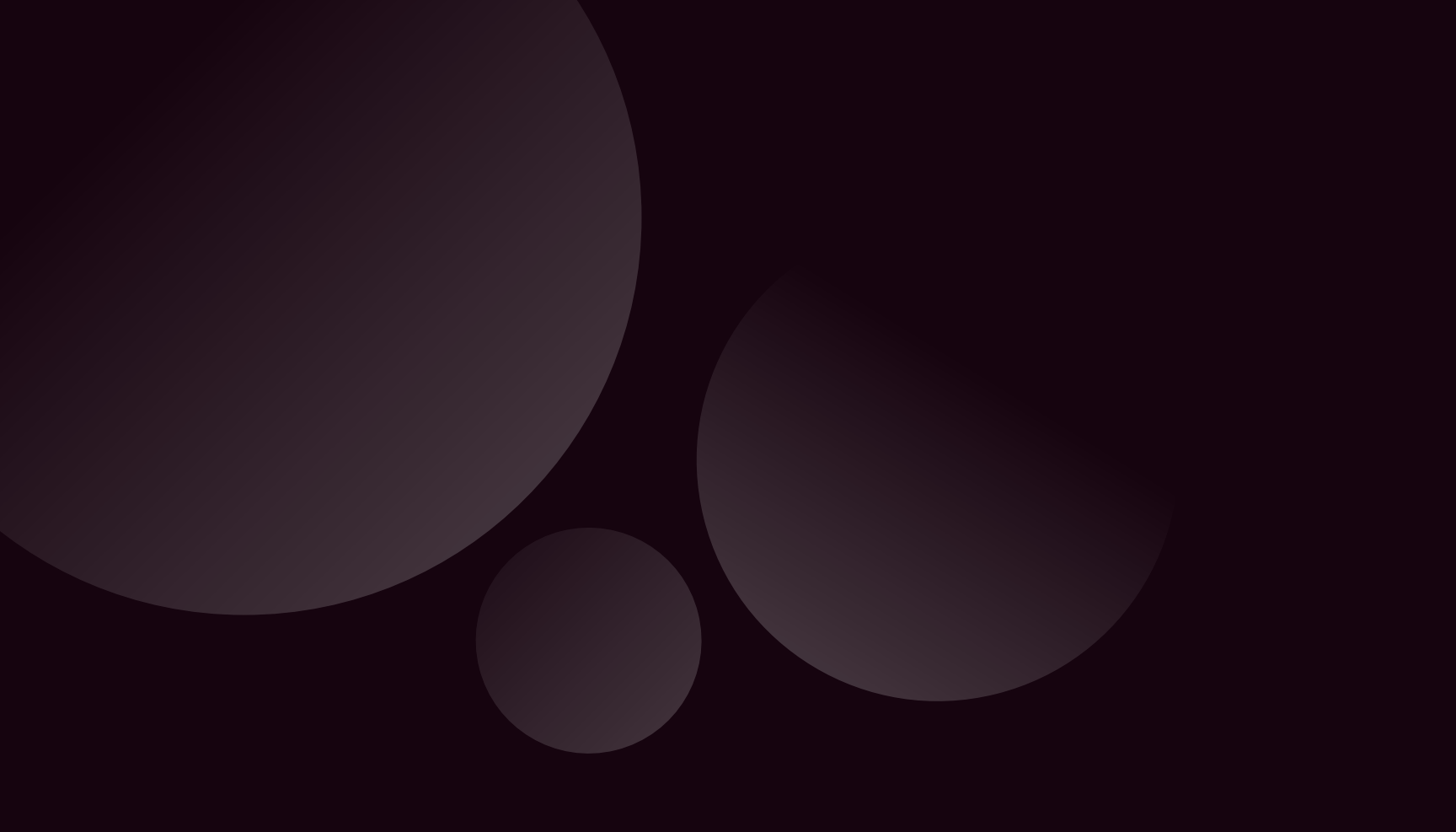
*Color. Clarity. Complete.*

CLARUS® 700 from ZEISS offers fundus fluorescein angiography (FFA) in an ultra-widefield view. Its high-resolution images provide detailed visualization of the retina—helping to identify capillary non-perfusion and intraretinal microvascular abnormalities—which is important in cases such as diabetic retinopathy where subtle details can inform the diagnosis.

[zeiss.com/clarus700](https://zeiss.com/clarus700)



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