

# Presbyopic Near Vision Mask Correction

by Quentin Bennett

From our early forties our ability to see things close to us deteriorates considerably in a process known as presbyopia.

This deterioration is even more noticeable in the darker conditions prevalent underwater, particularly in our non-tropical climes with their darker and murkier waters. The consequentially larger pupils make the effects of presbyopia even more obvious. I noticed the deterioration whilst diving long before I noticed it in normal life. Do understand that underwater, with wider pupils, the f stop of the eye is open, and consequently the depth of field is greatly reduced. This truly reveals that lessened ability to focus closely.

On land generally there are three ways to correct presbyopia : by using single vision near reading lenses, bifocals, or progressive lenses. Progressive lenses usually have the advantage that by using different areas of the lens corridor one can get different focal lengths and, therefore, adjust one's near vision focus distance.

In air progressive lenses are

generally the most convenient form of correction, but they are complex lenses and cannot satisfactorily be applied on the inside of a diver's facemask.

For some years we have endeavoured to mimic the effects of a progressive lens underwater by partially utilising a process known in the contact lens and refractive surgery worlds as simultaneous vision, or monovision. To function correctly the process is dependent on your possessing binocular vision, whereby both eyes function in unison and fuse the two eyes separate images successfully into one with 3D vision.

Remember that I am discussing this correction for near vision only, and particularly for underwater photographers and scientists who generally require a higher standard of vision than the everyday diver. Also, please understand that this process does not work perfectly for everyone, and that we are using it ONLY for intermediate and near vision, and NOT for distance vision.

With our technique we correct each eye separately for near vision



*Slug between the eyes", Fine-lined Tamaja (Tambja tenuilineata) on Northern scorpionfish (Scorpaena cardinalis) Tie-dye arch, New Zealand*

utilising a slightly different focus power. We then rely on the brain to fuse these slightly differing images to give a greater depth of field than is achieved with two lenses of the same power, as is normally prescribed.

An understanding of the dioptric power system is relevant here, but this is useful to all photographers, as we so often talk about diopter lenses.

The dioptric power of a lens is the reciprocal of the focal length in meters. As an example, a lens with a focal length of 50 centimeters, 1/2 meter, has a power of 2.00 Diopters. A

lens with a focal length of 33 cms, 1/3 m, is 3.00 Diopters, and so on.

So, from knowing the required focus distance, one can work out an approximation of the required lens power. Important to remember is the likelihood that if the diver still has some remaining accommodation, or internal ocular focussing power, these figures won't be absolutely exact, the focus will be closer, and a lower addition will be called for. Your ophthalmic practitioner will advise you on this.

As with everything when

dealing with human beings, there is great variance, and no two persons' requirements are the same.

As a generalised example of our monovision near vision correction, one may fit a +2.00 addition reading lens before the left eye. This should be perfect for reading one's pressure gauge, as its focus will be approximately at about 1/2 meter or 20 inches. Then the reading lens before the right eye may well have an +3.50 diopter addition, giving a focus for this eye at about 30 cm or 12 inches which is often convenient for looking at ones camera monitor screen and very small marine sessile creatures.

So, in this example, we have pretty acceptable focus, through the two near lenses combination, from about 55 cm to about 25 cm. The light level and pupil size can have an influence here, but we have found the technique very successful, and generally a great improvement over fitting both near vision segments of the same power.

Everyone is slightly different, and one needs to measure the distances at which you feel that you personally most need critical near focus, and then discuss this with your ophthalmic practitioner, who can demonstrate it in a trial frame. Perhaps print and take this article with you so that the practitioner can



*Deadman's fingers (Alcyonium cf. aurantiacum), Fiordland, New Zealand*

understand what you are trying to achieve. We all have our kit set up differently, and it is important that you provide your practitioner with the approximate working distances that you require.

This near simultaneous vision correction is made up as bifocals or as half eyes, so that you are corrected, as necessary, for normal distance vision at the top, and then have the bifocal segments for your closework at the bottom of the lens. Generally the top of this segment will line up with the lowest edge of your iris, the coloured

part of your eye. This may vary, depending on your requirements.

Having the segment too high interferes with looking into your eyepiece, but having it too low means that to view your monitor you have to either hold the monitor very low, or incline your head back uncomfortably. Combined with the limitations of mask design and optics, these can be annoying.

Having a mask with the glass close to the eyes is a great help, and a lot of masks of newer designs bring the glass back closer to the eyes.



*Blue-eyed triplefin (Notoclinops segmentatus), Poor Knights Islands, New Zealand*

So I believe that it is very important that a lot of care is put into the position of the top of the near optics section. As I say, the usual position is to place top of the near lens on a level across the very bottom of the ocular iris behind. Don't hesitate to fiddle around with a felt tip pen, your mask, and your camera, in a swimming pool, and see at what height you want the top of the segment, before committing.



*Jewel anemone (Corynactis australis), Matauri Bay, New Zealand*

Underwater photography apart, this system is convenient when diving, as it gives a practical range of close vision for finding different sizes of small and interesting creatures and the ability to read gauges, computers, and the like. Initially it can feel strange, but after a couple of dives one realises what a great improvement it is. Just like using progressive lenses in air, once one is used to it becomes intuitive and one never thinks about it.

For those affected, remember that presbyopia is a sign of maturity and, if you are diving, old age is still a very long way in the future !

### Stock Versus Bespoke Lenses for Distance Correction in Facemasks

Should you require correction of your vision for distance, discuss it with your ophthalmic practitioner. They will know firstly whether spherical lenses will correct you adequately, and whether horizontal centration of the lenses is critical.

If investigating stock divemask lenses check that the lenses to be supplied are the correct annotation. This means minus power if you are short-sighted or myopic, and plus



*Crocodile fish (Cymbacephalus beauforti) eye, night, Komodo Island, Indonesia*

power if you are long-sighted (far-sighted) or hyperopic. Diveshops often have little understanding of this and the other technicalities of vision correction that are relevant. Astigmatism is not correctable with stock divemask lenses.

Most stock mask correction lenses are of minus power, and these would be a disaster to a far sighted diver. I have “rescued” far-sighted divers who have had a diveshop attempting to sell them minus correction lenses.

Stock correction lenses supplied by the dive mask manufacturers

are spherical and ground with their optical centres at an average distance apart. Humans are all different and our personal PD or pupillary distance may well be very different from that provided by these stock lenses.

The type of diving that you do can be very relevant. The centration of the stock correction lenses may well coincide with your own pupillary distance (distance between pupils) which would ease any doubts as to whether they would be adequate.

Particularly in higher powers, poor centration of lenses causes induced prism effects which can lead



*Ladybug amphipod (undescribed Cyproideidae), Cannibal Rock, Rinca Island, Indonesia*

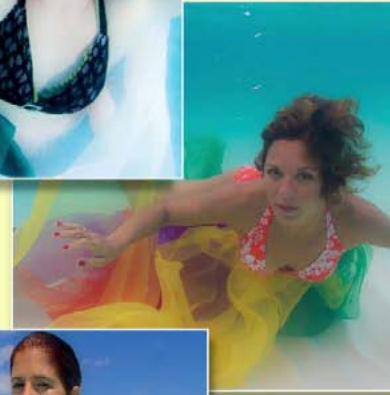
centration is even more critical than in an air environment. This is because narcosis, psychological and other effects can exaggerate the induced prismatic effects of a lens not centered correctly before the ocular pupils. From safety and comfort points of view, this could be less than satisfactory.

There also can arise the important factor of whether your astigmatism should be corrected. There are two almost counter arguments here. Firstly with your pupils probably open wider, especially in darker UK waters, you want the sharpest acuity possible. On the other hand the possibly slightly wet optics of a flat lens and the flat glass/water interface, vision is slightly compromised underwater anyway, and the lack of correction of a small amount of astigmatism is no great compromise. One very generalised guideline is to ensure that you pass or, better, exceed the driver's licence standards with your facemask correction! Discuss this with your ophthalmic practitioner.

**Quentin M. Bennett**

to considerable discomfort, perceptual changes, and even double vision. This is more likely if you are diving at depths where narcosis is likely to have an effect. Anyone who has worked with inexperienced ratings in a chamber knows that they are already getting a little tiddy-push at 20 meters of depth. At depth in water you are probably affected by narcosis to a greater extent than you realise.

In higher lens powers, lens centration cannot be out by more than a millimeter or so to fail ISO standards. I argue that in the underwater environment lens



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