OPTICAL CENTRATION IN DIVE MASK CORRECTION LENSES

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The correction of ametropia by the use of lenses cemented to the inside of the dive mask glass has been quite common for some years. Some European manufacturers, such as Cressi and Technisub, have offered custom ground lenses to fit several of their suitable masks. These are excellent systems that can be used to provide correction for a majority of errors.

Over recent years, in another trend, spherical minus corrective lenses have become available on an "off the shelf" basis to fit one or two particular masks.

The dive shop stocks these pre-machined lenses ready to be simply inserted into the mask aperture. A process that takes but a minute or so.

The advantage of this process is that it is quick and easy.

There are, however, two aspects of the procedure that I have strong doubts about.

One is that astigmatism that could be worthwhile correcting is ignored, leaving the diver with vision not quite as sharp as it could be. Many myopes, however, do have spherical corrections or only minor astigmatism. Unfortunately many divers appear shy about asking their ophthalmologist or optometrist whether their astigmatism is sufficient to justify correction.

My other doubt relates to the total disregard for the adjustment of the optical centres to the interpupillary distance (PD) of the patient with these ready machined lenses.

For a low prescription this may not be of great significance, but this type of lens is only available in the range of powers for which I believe that centration is significant.

My technician and I have looked at a number of these "off the shelf" minus corrections of powers up to -8.50 Dioptres available in New Zealand, but sourced from Japan. We found most to be centred at about 72-73 mm Pupillary Distance (PD).

The average New Zealander has a PD of 63 mm with the majority of Caucasian PD's varying within the 59 to 65 mm range. A PD of over 70 mm is very unusual.

The New Zealand Standards specify that optical centration of any spectacle lens over -1.25 Dioptres of power shall be correct within 1 mm and over 2.50 Dioptres within 0.5 mm.

Take the average "Kiwi Joker" with a PD of 63 mm and minus lenses centred for 73 mm down to a depth of 100 feet and he is likely to be very unhappy, suffering perceptual changes or "strain" and possibly diplopia, and potentially in danger. Obviously the deeper he goes the more acute discomfort and difficulties will be.

I frankly suspect that many divers are being affected by nitrogen narcosis at shallower depths than is generally recognised, particularly if they are cold or concerned.

Perceptual changes and particularly diplopia could cause a diver, particularly an inexperienced diver, quite some danger.

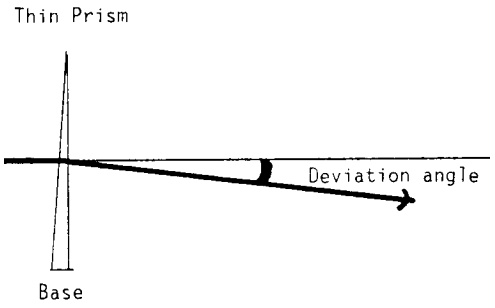

Figure 1. Light passing through a prism is deviated (bent) from its previous path.

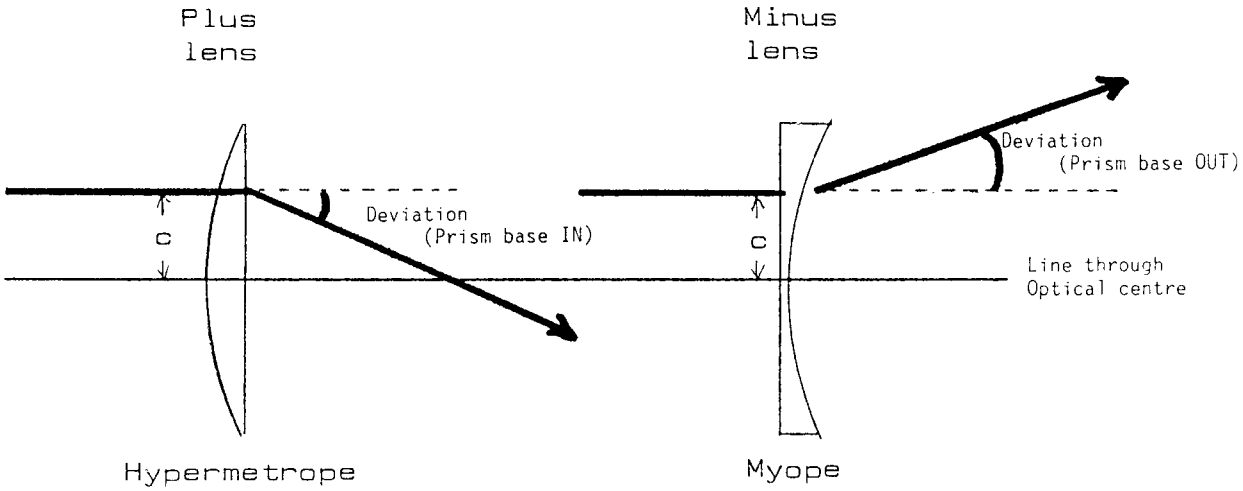

Figure 2. Deviation increases the further the ray of light is from the optical centre of both plus and minus lenses, used respectively from hypermetropes (long sighted) and myopes (short sighted).

Normally light passing through the optical centre of a thin lens is not deviated. However as one moves out from the optical centre a prismatic effect becomes manifest, deviating the light ray as demonstrated in the diagrams. This happens with both minus lenses (correcting myopes) and plus lenses (correcting hypermetropes).

The resulting prismatic effect at a given point depends on the power of the lens (F) and distance (c) in centimetres from the optical centre of the lens.

In Prentice's Formula, the prismatic effect P is given
P = F.c.

The combined effect of these prisms is to "push" or "pull" the eyes in or out in relation to each other.

The visual system possesses mechanisms able to accept a small variance in vergences, but this varies between individuals. It will be markedly affected by factors such as time, and conditions such as tiredness, concern and, especially, narcosis.

In the vaguest terms a diver is probably not going to wear a correction under about 2.00 Dioptres plus or minus and even at this power any more than a couple of millimetres error in optical centration creates prism not acceptable below 60 to 80 feet.

I accept that dive mask correction is more difficult to accurately centre than normal spectacles and for the odd outing of snorkelling or shallow scuba diving a little error in optical centration will not be of great significance.

Once the power comes up to 3.00 or 4.00 Dioptres, optical centration must be accurate, even for occasional very undemanding dives.

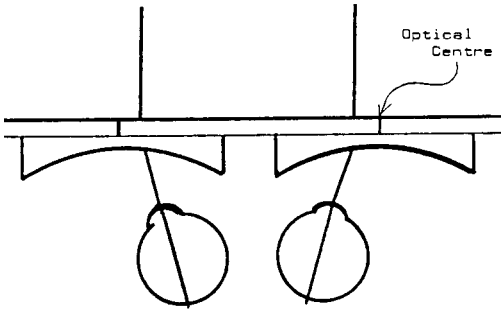

Figure 3. A myope using a mask with corrective lenses with the optical centres at more than his intrapupillary distance has the prism base in. Eyes cannot diverge therefore the diver becomes diplopic (sees double).

For deeper diving even low powered lenses must be accurately centred because perceptual difficulties and diplopia are the possible outcomes of incorrect centration.

The sudden onset of feelings of eyestrain and or diplopia would be difficult in any situation, but in an even mildly narcosed or concerned state underwater, it could have serious ramifications. As an inexperienced diver is most likely to be affected, these problems could definitely be serious.

With the present standards and system used in the marketing of these stock prescription lens masks in New Zealand, I do not find them acceptable, because of poor centration.

An improved system of warehousing in which lenses are offered with both different powers and optical centres would help change my feelings. I feel that the stocking of the lenses should be the responsibility of the warehouse as this is the only way a sufficient range of powers and centrations could be held.

I do not think that it is possible that an individual diveshop in Australasia could hold a sufficient range of powers and centrations to offer what I believe is the minimal stock lens service.

An adequate standard of prescriptions for our limited population base can be offered by means of a one off or custom prescription service provided by optometrists and dispensing opticians.

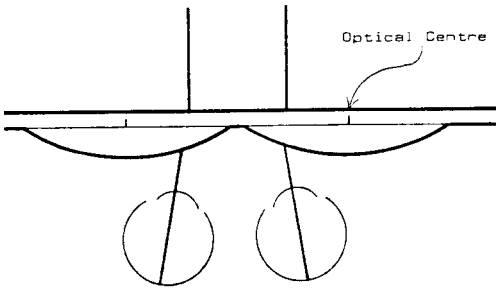

Figure 4. A hypermetrope using a mask with corrective lenses with the optical centres at more than his interpupillary distance has the prism base out. This requires the eyes to converge which elicits accommodation. The result is "eye strain" and possibly diplopia.

I have been interested to see in an Australian diving magazine an advertisement for a mail-order service fitting correction lenses to dive masks. This well laid out advert includes a form for prescription details but omits a PD or optical centration distance.

To my mind this bad omission unfortunately draws into disrepute the whole service of this particular firm.

I am sure that anyone within the ophthalmic professions would agree with me that no ophthalmic prescription can be acceptably filled without a specified PD.

I strongly feel that a custom made prescription whether done by one of the European firms such as Cressi or Technisub or by a local dispenser is the ideal facemask correction. Optical centration should be correct and any astigmatism can be corrected.

Divers should be advised to consult their ophthalmic practitioner if they have any doubts or queries regarding the necessity of correction of their astigmatism or optical centration.

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