Myopia prevention and control in the year 2020

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On 18 February 1999 the World Health Organization together with more than 20 international non-governmental organisations launched VISION 2020. The aim was to eliminate avoidable blindness by the year 2020. The project is driven by the International Agency for the Prevention of Blindness (IAPB). So we just arrived in the year 2020 and I am sure we shall soon see reports evaluating the success of this global initiative.

Studying the literature and reports on the management of refractive error and more specifically myopia I expect some alarming results. According to Global Burden of Disease estimates, uncorrected distance refractive error is the second largest cause of blindness and the leading cause of moderate and severe vision impairment in the world and I believe it is for this reason that it is important to find general and acceptable ways of dealing with the threat of myopia. According to a document released by the WHO in 2017, the direct and in direct loss of world productivity due to uncorrected refractive error, amounts several hundred billions US Dollars and is still increasing. Published estimates based on epidemiological studies indicate a meteoric rise in the prevalence of myopia and, if the current prevalence rates do not change, projections show that it will affect 2.56 billion people by 2020 and 4.75 billion people (49.8% of the world population) by 2050*.*

It should therefore be pretty obvious why myopia is now considered to be a pandemic. The impact of this on society as a whole is going to be immense. The burden this going to put on socio –economics, education and general family life, and if we add the current COVID-19 epidemic to this equation it may change our lives beyond what we ever could imagine. Children all over the world are forced to convert to e- learning and within a matter of weeks I was inundated with mails and calls that seem to lose their distance vision. One example was of a 9 year old boy that reported sudden reduction in his distance vision. His subjective refraction result was -2.50 but after doing cyclopegia this was reduced to -0.50. With children now spending as much as 12 hours on hand held devices this is going to become the norm and I am deeply concerned that these children will be given these myopic scripts.

For us as optometrists the management and control of myopia should be non-negotiable if we wish to make a meaningful contribution. We simply need to make paradigm shift in the way we practise. A worldwide survey on myopia attitudes and practices, published in April 2016 in Contact Lens and Anterior Eye, confirmed that while most practitioners said they were concerned about myopia and felt they were active in myopia control, the majority were still prescribing single vision distance spectacle corrections, which have demonstrated no useful propensity for myopia control. Kate Gifford summed it up best when she remarked that “There was definitely some hesitancy in putting control strategies in place”. Progression of children with full time correction is greater than those who were not corrected at all**. “Either way, bumping up the minus to temporally optimize distance acuity is a lot like putting studded tires on your car all year long. They’ll work great the few times when you need them; but, the rest of the time you’ll burn more energy trying to get to where you need to be and they’ll also wear out within the year”.**

The prevention and management of myopia can only be successful if we have a clear understanding of the aetiology thereof and herein lies the biggest problem and challenge. There seem to be lack of consensus among researchers on this matter. At least it is now generally accepted that genetics is not the only factor, but just one of the risk components in a condition where several factors seem to contribute. This has also resulted in different organisations and researchers attempting to enter into the “nature vs. nurture” debate by producing various classification systems for myopia to try and separate genotypic causes from other phenotypic factors.

There are several web-based programmes available to assist you to develop your own management and control strategy. We just saw two new concepts added to our vocabulary – Zoom meetings and Webinars. You can even join one of them if you wish. The programme that I found the most useful is the one been launched by the Brian Holden Vision Institute a couple of years ago. It merges individual patient information with a range of optical and pharmacological treatment options for myopia. The one serious shortcoming for us in South Africa is that it only deals with Asians and Caucasians and does not make provision for Africans. Nevertheless once you uploaded the patient’s ethnicity, age and refractive the myopia ‘calculator’ allows practitioners to predict how myopia will progress under different treatment options, compared to single vision spectacles for distance. The range of management options that can be selected with the calculator, include multifocal soft contact lenses, peripheral defocus spectacles, executive bifocals, progressive addition spectacles, orthokeratology as well as low and high dose atropine. These risk calculators should not be confused with other myopia calculators that allow you to determine you own amount of myopia and order your spectacles over the internet.

No matter what theories or treatment strategies you ascribe to, it won’t change the fact that number of myopic or soon to be myopic children coming into your practice will continue to increase. Each of these programmes has its own pros and cons and I did not find one that suits al my needs. I have therefore developed my own approach based on three principles.

* Prevention is better than cure.
* Myopia is a predisposition not a destiny
* Theory versus Practice.

***Prevention is better than cure.***

This may require a change in mind set because we are so used to wait for myopia to appear and then simply correct distance vision. The hardest part may be to convince the parent and their child [and the medical aid] that prevention is better than cure. This approach requires an in depth case history to try and determine the risk for myopia. It is not surprizing to see that this massive increase in myopia in the child of the 21st century is coinciding with the increased number of hours young children are spending on hand held devices. Although in certain circles the causal link between near work and myopia development is still contested I have no doubt that the learning and social environment is the main cause for the boom in myopia. Therefore prevention starts by managing the time children spend at near point activities. Research done by the AOA is showing that children are spending more than eight hours per day on hand held devices. Loss of focus and blurred vision at near relates to fatigue in the accommodative system. Blurred vision at distance may be a little bit more complex. The literature suggests that this is the result of a short-term myopic far point shift immediately following a sustained near visual task. This is known as near work-induced transient myopia (NITM). Overall, studies reported myopic shifts, with a mean of approximately 0.40 D and a range from 0.12 to 1.30 D. In the vision care domain we are now also seeing other disturbances on the visual system. In 2016 Lee and colleagues reportedon an unusual presentation of esotropia, known as Acute Acquired Commitant Esotropia [AACE] in children using smartphones for more than four hours per day. In my own practice I have seen 10 children between the ages of two and six years over the last eight months presenting with AACE related to the excessive use of hand held devices.

Therefore prevention of myopia, and even other conditions start with the management of the time young children spend on near visual tasks. In her myopia prevention programme Kate Gifford is also putting a lot of emphasis on this concept and stresses the need for children to participate in outdoor activities. It is important that parents should be informed about this because they are the ones that will have to manage this. More so if one or both parents are myopic it increases the risk for the child to develop myopia. It is also recommended that children should be tested annually to allow for early detection and management of myopia. If I find a child at the age of 7 years to present with +0.25 or even plano, it immediately sets of the alarm bells. Kate Gifford follows an even more cautious approach by suggesting that +0.75 or less should be the limit.

***Myopia is a predisposition not a destiny***

Myopia is probably the best example of the rift between past and present thinking. Twenty years ago I was heavily criticized for suggesting that myopia is far more environmental than genetic. This nature vs. nurture debate is still ongoing with the old traditionalists still considering it as a genetic “illness”. The simple fact is that the human genotype takes thousands of years to evolve and adapt and can therefore, not be the reason for the exponential increase in myopia. This can only be the function of the phenotype – or the interaction between humans and their environment. The old guard now refer to myopia as “a polygenic multifactorial disease governed by both genetic and environmental factors”. I do not feel comfortable with the use of the word disease. This, however leads to the following debate: can it be cured, controlled or prevented? My own research clearly shows that it can be prevented or controlled in most children. The exceptions are the pathological myopes which to my mind are the only true genetics ones. This is in line with a more modern take on myopia that is beginning to take shape, which suggests that myopia is not an illness at all. Rather than being an illness, it is becoming more evident now that myopia is first a symptom of eye strain, and later, with the current outdated “treatment” methods, becomes a response to defocus stimulus. Our current environment is definitely making us more susceptible for myopia but in the words of Steven Turpin as long as we realise that it is a “**predisposition and not a destiny**” it can be prevented or controlled in most cases.

***Theory versus practice***

For whatever reason the prevention phase was not implemented or adhered to and now we sitting with a child that has become myopic. You may notice that the emphasis is on dealing with children but you may have to help adolescents or adults that missed out on early detection or developed a late onset myopia. Anyway you now have to make a decision on what myopia control modality to follow. As mentioned before you will find a whole range of management options but selecting the appropriate one can become a minefield. If you study all the different myopia control models you will find some substantial differences on the efficacy of the different modalities. To me this presents a conflict between **theory and practice**. All studies are guided by the specific aetiology the authors ascribe and the methodologies they applied.

The most popular modalities are multifocal soft contact lenses, peripheral defocus spectacles, executive bifocals, progressive addition spectacles, orthokeratology as well as low and high dose atropine. The obvious exclusion is visual therapy.

To me the conflict between theory and practice is no more obvious than in the use of **atropine.** In some studies, atropine has been shown to be the most effective way of controlling myopia. Rates averaging about 77% has been reported but there was a significant rebound effect when the treatment is stopped. Now we know that atropine is commonly used to induce cycloplegia i.e. to paralyze the ciliary muscle and thereby suppressing accommodation.

This is where I get confused. The theory behind this approach is to prevent ocular elongation and they are achieving this by suppressing accommodation although they don’t support the accommodative dysfunction concept as the cause for myopia. Furthermore atropine also causes the pupil to dilate so while atropine may prevent or control myopia it will impact directly on a child’s ability to focus and concentrate on near work tasks. More so if you add the third element of the near triade, namely convergence, to the equation. Since these three systems are neurologically linked it is reasonable to assume that it will also impact on convergence function. Therefore although it may prevent myopia it will have a dire effect on the child’s learning and reading ability. It should also be note that a number of case reports also warned against mental toxicity and even death with chronic use of atropine. The success that is achieved with atropine also creates conflict with the peripheral blur theory that links myopia progression to a blur in the peripheral retina. Supporters of this concept would therefore suggest multifocal soft contact lenses and peripheral defocus spectacles. Atropine will certainly cause a defocus in the peripheral retina but this did not induce myopia. Thus in theory atropine therapy seems to be working well but in practice it raises many questions.

**Multifocal soft lenses** are been promoted by several authors as the option of choice to slow progression in myopia (about 49%). These studies reported similar results for both concentric ring add designs and aspheric add designs with adds of between +2.00 and +2.50 D. There are a number of companies making centre distance multifocal designs. Supporters of the peripheral blur theory suggest the smallest centre optic diameter tolerable with the largest add power would provide the best results. Another option that is less recognized as a potential modality is the centre near multifocal soft lens. This lens design also meet the requirements of the blur theory and even fits the requirements if the near point stress theory holds true.

Again in theory it seems to be a good option but according to Steven Turpin for several reasons multifocal contact lenses do not seem to be a preferred choice by many optometrists. I believe it may simply be because of the practical considerations that come into play. Because of the drive to start prevention as early as possible i.e. with young myopes compliance in taking care of their lenses is a big factor. My experience is that many young children also objects to put “something” in their eyes. They also give up very quickly if they can’t get the lens in quickly. It is an option worthwhile exploring and it may be more suited for myopes in the mid-teens. Because compliance remains a big concern frequent replacement of the lenses is advised which makes it a costly option and this will put it out of reach of many young myopes. I am not fully convinced by the peripheral blur theory and my biggest concern is the impact of peripheral blur on the superior colliculus visual pathway.

**An option that is certainly growing is the use of Multifocal/Bifocal spectacles** although research is showing a mere 30 to 45% reduction in myopia progression. Again this is a classic case of theory versus practice. The principle behind the use of this modalities is sound but in practice compliance is the biggest challenge. Optical companies are punting Progressive Addition lenses (PALS) and report much higher success rates. The reason for this is that their studies are done under controlled conditions where they ensure that the children are using the lenses correctly. In real life this is not happening since we have no control over which part of the lens children are looking through and most of them are dropping their chin when reading and therefore not using the reading area. I have recorded several videos to prove this and showed it to parents. Children don’t experience any blur as a warning that they are not using the correct area of the lens. This certainly explains the variable results reports in several studies. For this reason I prefer to use bifocal lenses, fitted higher than usual. Children adapt to it very easily and the “Jack in the box” effect serves as an excellent reminder to use the lens correctly. For this reason I am recording a success rate of more than 70%. Some will argue that an executive bifocal provides larger area of peripheral myopic defocus and that’s why they should be preferred to normal flattop bifocals. Again practical considerations rules. Children of today don’t mind to wear spectacles but don’t like the look of the executive bifocal lenses and may refuse to wear it. Achieving outstanding results with the normal flattop bifocal I don’t see a need to use anything else. The obvious question then becomes, how much add power? Looking at the literature you will find suggestions that range from +3.00 down to +0.75 based on what people belief of what myopia really is. Those arguing the peripheral blur theory mentioned earlier may say a higher add power (+2.50) would provide more peripheral myopic defocus strictly based on the optics but this has not yet been proven. The group arguing the near point stress theory would say that this is much too high and that it should not exceed the fused crossed cylinder measurement. From my own experience this test is the worst indicator because of fluctuating accommodative flexibilities. From a practical point, children find the jump from distance to near produced with high adds to be uncomfortable. A middle of the road approach of +1.50 has proven to work for me. The big challenge is compliance – if you can ensure that the glasses are used correctly than you should also be able to achieve high success rates.

With an average reduction in myopia progression of 43%, **Orthokeratology [Ortho-K]** is now seen by several authors as the best option. It is not something new and Paul Ramkissoon did his Ph. D with me in 2003 on this topic. It is probably the most nuanced and technically difficult modality to use and you need a big fitting set and lots of chair time to ensure no permanent changes or damage to the cornea. Critics are claiming that it may indeed cause damage over time. It can be considered an invasive process and therefore requires regular follow-up visits making it a costly option. Sadly non-compliance by most patients is a big problem and again may not be a good practical option for young myopes.

All the proposed modalities have two things in common. The first being that you dealing with a patient that has already become myopic. Secondly all modalities seem to try and manage the strain on the accommodative system. I therefore find it difficult to believe that a significant number of researchers still oppose the near point strain concept. To me it is fundamental in the whole process of myopia control. This is why the **concept of prevention** becomes even more important. I we can do the same thing i.e. reduce the strain on the accommodative system when the warning signs start appearing we may just be able to prevent the onset of myopia. I have been doing this for several years and is achieving great success, even in children where both parents are myopic. Therefore although single vision reading glasses is a modality not mentioned in myopia control management programmes it is an option very worthwhile to pursue.

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