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CPD CODE: C-107280

Young adult **myopia**

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We know that myopia is becoming increasingly common around the world[1] and that there are several interventions that have been shown in research to slow the progression of myopia in children by an average of around 50 per cent[2-4]. An area that has received less attention up until now is myopia onset and progression in young adults. This article examines the evidence around myopia in young adults and discusses the implications for how young adult myopes are managed in practice.

For the purposes of this article, 'young adults' will be defined as those aged 18 to 25 years. Myopia progression is commonly seen in older adults, but this is normally due to changes in the crystalline lens (e.g. nuclear sclerosis) and not due to growth of axial length, which will be discussed here. Axial length is the distance from the anterior surface of the cornea to the retinal pigment epithelium at the back of the eye, with the average axial length for an emmetropic adult being 23.75mm[5]. Most myopia is axial in nature and each 0.1mm of extra axial growth equates to 0.25-0.30D of myopia[6].

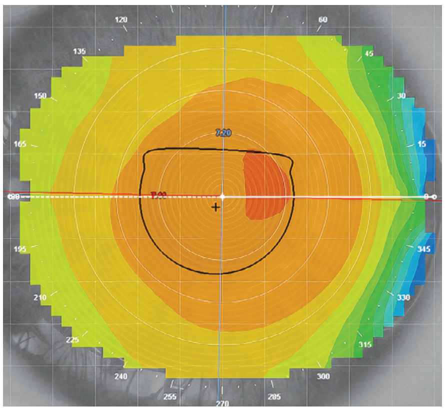

FIGURE 1: Topography showing refractive myopia. This individual has an axial length of 23.98mm, corneal curvatures of 7.20/7.11mm and a resultant refractive error of -4.50/-1.25x90

The increase in axial length, which is most commonly the cause of myopia progression, is the factor that increases the risk of future ocular health complications such as retinal detachments and myopic maculopathy[7]. However, myopia can also be refractive in origin, where the cornea or crystalline lens are steeper (and therefore more powerful) than average, so performing topography or keratometry is useful to understand the contribution of the cornea to overall refractive power (**Figure 1**).

Axial length is vital to look at when considering the risk of future ocular pathology. A -2.00D myopic eye with very flat corneas and a longer than expected axial length may be at greater risk than the prescription alone suggests, while a -4.50D myopic eye with very steep corneas may be at lower risk. A cross-sectional study in the Netherlands found a cumulative incidence of visual impairment of 3.8 per cent in adults aged 75 years with an axial length of 24-25.99mm while this rose to 90 per cent for those with an axial length of 30mm or greater[7].

Axial length can be measured quickly and easily in practice using optical biometry, which is a non-invasive technique (**Figure 2**). If you do not have access to a biometer in practice then axial length can be estimated by use of a formula or an online calculator by inputting keratometry readings and the results of a cycloplegic refraction[8].

FIGURE 2: Image of a biometer (MYAH, Topcon Healthcare) which can measure axial length

If you are using this method to monitor any axial length progression, then it is important to use the same formula each time as the results vary between the different versions.

Axial length growth curves are available that allow for comparison of a patient's measured or estimated axial length with the average for that age. They can also be used to monitor the effectiveness of any myopia management undertaken[9]. Axial length (when measured by optical biometry) is a much more accurate and repeatable measure than objective or subjective refraction and can detect smaller changes[10]. This makes it an ideal measurement to be used both in clinical practice when engaging in myopia management and also in research studies looking at myopia progression.

MYOPIC PROGRESSION IN YOUNG ADULTS

For this article, adult onset myopia is defined as onset of myopia in an emmetrope or hyperope over 18 years of age and adult myopia progression will be defined as an increase in myopia in an existing myopic individual over 18 years of age. These are both less common than juvenile onset myopia which we will briefly review here first.

The majority of myopia is classed as juvenile onset and this most commonly begins between the ages of eight and 13 years[11]. The average age of stabilisation was found to be 15.6 years (+/-4.2 years) in the COMET study in 2013 (**Figure 3**). There was some variability found due to ethnicity in this large study based in the USA, with African Americans stabilising at a mean of 13.8 years and White and Asian participants stabilising at ~16 years[12]. There was no difference found due to sex, unlike in an earlier study which found myopia to stabilise earlier in female participants than male[13]. However, the COMET study also found that 23 per cent of myopes were still progressing at age 18 and 10 per cent at age 21, showing that a significant minority of these juvenile myopes continue their progression into adulthood.

Several studies have examined myopia progression in young adults between the ages of 18 and 25 years. A recent large study based in Australia examined 691 participants at the age of 20 and again at the age of 28[14]. They found that 38 per cent of the participants experienced a myopic shift of -0.50D or greater over the eight-year period and the mean annual rate of progression was -0.04D.

Two large practice based studies in France[15] and the Netherlands[16] found similar annual rates of progression in myopes in this age group at -0.10D and -0.08D respectively. A cohort of myopic Finnish schoolchildren were followed for up to 23 years into young adulthood, and 45 per cent of them continued to show some progression while aged 20 to 24 years. The mean annual progression in this group was -0.06D[17].

Another recent longitudinal study in Singapore examined the change in refraction from visits in adolescence (ages 12 to 19 years) and young adulthood (ages 26 to 33 years) and found that 38.7 per cent of participants progressed more than -0.50D in 10 years with annual mean progression of -0.04D[18]. Female participants had higher odds of progression (odds ratio 1.7) and those of Chinese ethnicity were more than two times more likely to show progression.

Other studies have looked specifically at university students, and they have typically found the proportion of participants progressing and the rates of progression to be higher than in the studies looking at general populations. This might be explained by the association that has been found both in Asia and Europe between increasing educational attainment and myopia[19].

A two-year study of medical students in Denmark found mean progression of -0.20D per year[20] while a three-year study of Norwegian engineering students found 32 per cent of myopes progressed by at least -0.50D and a mean annual progression of -0.22D[21].

A three-year study of Portuguese university students found a lower mean annual progression of -0.09D, while 22 per cent progressed by at least -0.50D over the study duration[22]. Two similar studies were completed with Chinese university students over a two-year period and they found similar mean annual progressions of -0.18D[23] and -0.19D[24].

A study of Chinese medical students found that 27 per cent progressed by at least -0.50D over the two year duration and the mean progression was -0.20D[25].

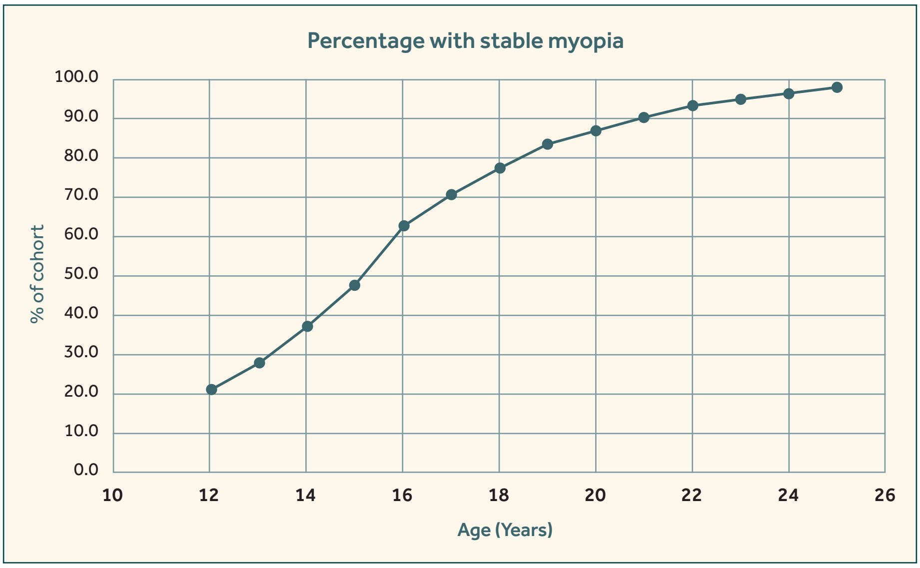

FIGURE 3: Data redrawn from the COMET study[12] showing the percentage of myopes that were stable across age groups

AUTHORS	POPULATION	MEAN ANNUAL PROGRESSION (D)	MEAN AXIAL ELONGATION (mm)	CYCLOPLEGIA USED
Lee *et al*[14]	Australian birth cohort	-0.04 (a)	+0.02 (a)	Yes
Ducloux *et al*[15]	French practice population	-0.10 (m)	Not measured	No
Polling *et al*[16]	Dutch practice population	-0.08 (m)	Not measured	No
Parssinen *et al*[17]	Finnish adults	-0.06 (m)	+0.04 (m)	Yes
Li Lian *et al*[18]	Singapore school cohort	-0.04 (m)	Not measured	Yes
Jacobsen *et al*[20]	Danish medical students	-0.20 (m)	+0.07 (a)	Yes
Kinge *et al*[21]	Norwegian engineering students	-0.22 (m)	+0.13 (m)	Yes
Jorge *et al*[22]	Portuguese university students	-0.09 (a)	+0.04 (a)	Yes
Lv & Zhang[23]	Chinese medical students	-0.18 (m)	Not measured	Yes
Bai *et al*[24]	Chinese university students	-0.19D (a)	+0.06mm (a)	No
Duan *et al*[25]	Chinese medical students	-0.20 (a)	+0.05 (a)	Yes
Khan *et al*[26]	Australian clinical trial cohort	-0.09D (m)	Not measured	No

TABLE 1: Comparison of studies discussed above in order discussed in text (m =values represent myopes only, a = values represent all refractions)

These studies all looked at participants with myopia, hyperopia and emmetropia – but when results were broken down by refractive status, the largest average progression values were seen in myopes.

A recent Australian retrospective practice study highlighted the differences in progression between student and general populations[26]. Participants were split into those in a 'high learning environment', which included students and academics, and 'others'. Mean annual progression for all myopic participants aged 18 to 21 years was -0.10D, while it was slightly lower for those aged 22 to 26 years at -0.08D; 18.3 per cent of participants aged 18 to 21 years progressed by -0.25D or more per year, as did 10.9 per cent of those aged 22 to 26 years. Being in a 'high learning environment' increased the odds of progression by more than two times.

There were many methodological variations in the way that these studies were conducted, for example, in the average age of participants, the duration of the study, whether or not refraction was measured under cycloplegia, and the amount of change in prescription that was counted as progression. A selection of these studies are included in **Table 1**.

Some of the studies only looked at myopes, who are more likely to progress, while others looked at all refractive errors. These factors explain some of the variability in the results. Overall, the proportion of patients still progressing in this age group was found to be between 22 and 56 per cent[27].

In summary, a significant minority of young adults aged 18 to 25 years are still progressing and some population groups, for example, students, are more likely to keep progressing. This adult progression has been shown to be due to an increase in axial length[20,22] rather than corneal and lens changes, and so carries the same ocular health risks as juvenile myopia progression.

ADULT ONSET MYOPIA

In addition to considering myopia progression that continues into adulthood, it is important to look at myopia that begins in adulthood in those who were previously emmetropic or hyperopic, which we will term 'adult onset myopia'.

There are two research techniques that can be used to study adult-onset myopia: cross-sectional studies look at a group of participants and use questionnaires or surveys to ask them when they first became myopic, while longitudinal studies follow a group of participants over a time period and see how many become myopic.

A recent review[27] looked at the results of 14 cross-sectional studies and found that between 15 and 81 per cent of the myopes reported adult onset. These studies can again be divided up into those that looked at the general population and those that looked at a student population.

A study into university staff in the USA found that 37 per cent of them reported adult onset[28], although in this paper adult onset was defined as above the age of 15 years. A study on Australian twins found that 28 per cent of them reported receiving their first prescription at or after 18 years of age, and more than 90 per cent of these adult onset myopes were between the ages of 18 and 30 when they first started wearing spectacles or contact lenses[29].

Cross-sectional studies that looked at student populations include a cohort of Norwegian medical students, in which 43 per cent reported onset of myopia after 20 years of age[30] – and a cohort of Turkish medical students, 15 per cent of whom reported onset after 18 years of age[31]. All these cohort studies are relying on people self-reporting when they first became myopic, and this will add some significant variability into the results. The studies also vary in how they defined the criteria for adult onset and how far into the past they were expecting people to remember based on the average age of the participants.

Nearly all longitudinal studies looking at adult onset myopia have been completed on student populations, the exception being the Australian birth cohort which was followed between the ages of 20 and 28 years – with 29 per cent of all myopes in the cohort having adult onset[14].

The percentage of adult onset myopia amongst myopes in the student populations studied in seven longitudinal studies reviewed recently[27] range from one to 27 per cent with the majority around the 20 per cent mark. The two lowest percentages found, at one and six per cent, were both in Chinese student populations – where the prevalence of juvenile myopia is extremely high meaning that the vast majority of students were already myopic before reaching adulthood[23,25].

Examining the results of all these studies we can see that adult onset myopia affects a significant minority of patients over the age of 18 years and yet there is variability in the data reported. This may be due to different cut-off ages being used, different study designs, different populations being studied and the inherent variability in questionnaire data especially when asking participants to remember an event which may be some time in the past.

The takeaway message here is that myopia can begin in adulthood and these patients, especially those in higher risk categories such as students, should be made aware of advice as we would for higher risk children and continue to attend for regular eye examinations.

MANAGEMENT IN PRACTICE

So, what does this research about adult myopia progression and adult onset myopia mean to eyecare practitioners seeing these patients in practice?

Firstly, as we know that a significant minority of juvenile myopes, who may be using a form of myopia management, will continue their progression beyond the age of 18 years we need to take this into account when making any decisions on when to cease treatment. This judgement should be based on stability of refraction and the lifestyle of the patient, for example considering if they are they still studying. This suggests that older patients who weren't started on myopia management in childhood could still potentially benefit from an intervention as a young adult, if there is evidence of continuing progression.

We can also see that a significant proportion of young adults will have adult onset myopia and, although these patients are less likely to end up with very high prescriptions, using some form of myopia management may enable them to retain a useful functional level of uncorrected vision. It is important to remember that even very small annual changes in prescription can add up over many years increasing the risk of future ocular health complications; an increase in myopia of -0.05D per year between age 20 and age 40 is an extra -1.00D of risk.

Being able to identify young adults who have the potential to benefit from myopia management techniques is the first stage in the process, but thought must then be given to the management technique that will best suit the patient and their lifestyle.

Research has shown that both myopia management soft contact lenses and spectacle lenses work best when worn full time[32,33]. Adult onset myopes who have only a small prescription may not need or want to wear their correction on a full-time basis, so careful counselling would be required to make sure they are getting the full impact of any myopia intervention.

Orthokeratology lenses have the benefit of freeing the patient up from their glasses or contact lenses during the day but take an additional commitment of time and cost beyond a standard refractive correction. All the interventions can potentially affect the quality of vision[34], particularly low contrast visual acuity, and while we have evidence that children adapt quickly to these corrections[33] we do not know whether the same acceptability will be found for young adults.

We have some short-term data on how adults adapt to MiSight contact lenses over a week of wear which show that ghosting and haloes seem to be an issue that restricts the lens wear time initially[35] (**Figure 4**). Young adults may adapt to these issues in the same way that children do, but patients would need to be counselled on what to expect when wearing these options in much the same way that we would give advice when dispensing a first pair of varifocals or multifocal contact lenses.

There is currently no published research on the efficacy of any of the myopia management interventions in this age group, although adult progression is related to growth in axial length in the same way as juvenile progression so it may be reasonable to assume that they should work in a similar way.

MiSight contact lenses and the spectacle lens options are licensed up to the age of 18 years so their use in a young adult would be considered to be 'off-label'. The latest myopia management guidance published by the College of Optometrists states that products can be used off-label if there isn't a licensed alternative, the clinician has good reason to think that the treatment will work[36].

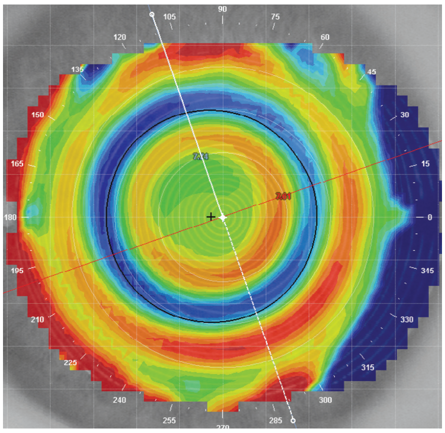

FIGURE 4: MiSight topography image showing the front surface of the lens

Informed consent for the patient is vital when we are using a treatment off-label, being especially clear on where we have evidence and where we don't, as well as the risks and benefits of any treatment. Advice can also be given about working distances and outdoor time just as it would to younger age groups.

Stable adult myopes can be warned about the signs and symptoms of ocular diseases and the importance of regular eye examinations, while any myopic parents should be informed about myopia management, preferably before their child becomes myopic, so they have time to consider the evidence before making a decision.

SUMMARY

In summary, the effect of adult myopia onset and progression should be considered in practice as the research shows that significant minorities of the population will fall into one of these categories. By identifying patients who fall into these groups as early as possible, we can offer advice and possibly myopia management.

KATHRYN WEBBER is an independent prescribing optometrist and educator working at the University of Bradford where she founded and runs the Myopia Management Clinic. She was awarded the British Contact Lens Association's Myopia Management Practitioner of the Year Award in 2023. She is also a part-time PhD student at the University of Bradford where her research is looking at interventions to manage young adult myopia.

DR MATTHEW CUFFLIN is an optometrist and lecturer in optometry at the University of Bradford, where he teaches low vision and ocular pharmacology. He was awarded his PhD in 2008 for an investigation into the response to blur in myopes and emmetropes. His current research investigates accommodation and myopia progression in young adults.

LEARNING OUTCOMES FOR THIS CPD ARTICLE

DOMAIN: Communication

1.3: *Assist young adults at risk of progressive myopia and those with adult-onset myopia to make informed decisions about their eyecare.*

DOMAIN: Clinical Practice

5.3: *Be aware of the latest clinical research in the area of young adult myopia and consider how this may impact your clinical practice.*

7.5: *Provide effective and evidence-based care and treatment to young adults with myopia.*

DOMAIN: CL speciality

Consider how the current understanding of young adult-onset myopia and myopic progression in young adults influences your contact-lens practice and patient communication.

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