

FEOPH SYMPOSIUM AT THE 98th SOI NATIONAL CONGRESS – ROME, 1st DECEMBER 2018

Talk: “Fighting myopia: review of the literature” (M. Wurtz)

Prevalence of myopia has increased in many countries: in Europe, it involves more than 35 % of the adult population, in the USA the prevalence has increased from 35 % to 41.6 % over the last 30 yrs. In East Asia, the prevalence of myopia in adult population reaches almost 70 %, whereas in urban areas of Asia, like Singapore, myopia can reach up to 86 % in teenagers.

The risk factors of myopia are well known: near-vision work and little outdoor activity are some of the major ones. In addition, parental myopia and Asian ethnicity are considered as risk factors.

Managing myopia progression is a major public health issue to address in order to prevent the complications related to this condition such as retinal detachment, glaucoma and macular degeneration. It is also important to control health spending.

In a recent meta-analysis, 16 methods to prevent myopia progression were reviewed. Axial length and refractive change were addressed. Among all the methods reviewed, only 3 were found able to significantly and clinically reduce axial length progression:

- Atropine (ranging from 0.01 to 1 % concentration)
- Ortho-K
- Peripheral defocus modifying contact lenses.

ATOM 1 study examined the effect of atropine 1 % in the progression of myopia in children: the eye treated with a single drop of atropine once nightly showed a reduction in myopia progression compared to the non-treated eye. Similarly, the eye treated displayed a reduction in axial elongation compared to the non-treated eye.

ATOM 2 study examined the effect of atropine 0.5 %, 0.1 % and 0.01 %. All concentrations of atropine showed a reduction in myopia progression, and a dose-dependent response was observed for refractive change with each concentration of atropine. Similar results were obtained regarding axial length: a reduction of eye elongation was reported with any concentration of atropine.

No systemic side effects were observed with atropine. However, atropine 0.5 % and 0.1 % showed ocular side effects like accommodation disorders, pupil dilation and near-vision impairments.

On the other hand, atropine 0.01 % had only minimal side effects and comparable efficacy in controlling myopia progression thus resulting the best option among the different atropine concentrations.

Defocus soft CLs are another method to control myopia progression. These lenses create a myopic defocus in addition to the retinal focus. The study used a crossover design to analyse the effect of

defocus CLs on myopia progression: every child had to wear the DCL in one eye and a single vision CL in one eye. During the first 10 months of the study, the eye wearing the DCL showed a reduction in myopia progression compared to the eye wearing the single vision CL. At 10-month crossover took place: the two lenses were switched between the two eyes resulting in the same outcome in terms of reducing myopia progression. Similar results were obtained in terms of axial length in the eye wearing DCL.

Ortho-K has also proved its efficacy to control myopia progression. In a 5-years study, Ortho-k was found able to reduce axial length progression compared to spectacles. However, one might wonder what happens after stopping treatment: in ATOM 1 study after 2 years of treatment atropine discontinuation revealed a rebound effect with higher rates of myopia, but after 1 year of atropine discontinuation, eyes treated with atropine still had a significantly reduced axial length compared to untreated eyes. Similarly, after stopping Ortho-K, a rebound effect and higher rates of myopia were observed.

In conclusion, the most effective methods to reduce myopia progression are atropine eyedrops, defocus contact lenses and Ortho-K. Atropine 0.01 % seems to be an easily manageable method with minimal side effects on accommodation and near vision. In Strasbourg, a clinical study is going to be carried: the effects of atropine 0.01 % are going to be studied in a multicentre European cohort of children.

**Talk: “Lamina cribrosa defects: a diagnostic criterion of glaucoma in myopic patients?”
(N.H. Asselborn)**

Glaucoma is one of the main causes for blindness worldwide, and myopic patients are at much risk of developing it. In addition, in myopic eyes anatomical changes of the papilla and the extended eye bulbus make the detection of glaucoma more difficult. Studies indicate a higher prevalence of defects of the lamina cribrosa (LC) in patients with myopia and glaucoma. These defects can increase the likelihood for glaucoma in myopic eyes. The aim of the study was to investigate LC defects in myopic eyes with and without primary open-angle glaucoma using swept-source-OCT technology. A prospective longitudinal observational study was conducted enrolling 84 myopic eyes (range of spherical equivalent -2 to -8 D), 23 cases of the total were characterized by open-angle glaucoma. Swept-Source OCT scan (Topcon DRI OCT Triton) with sector scan and imaging of the peripapillary retinal nerve fibres was performed in all eyes. All LC defects were manually measured and classified with Topcon software IMAGEnet and a differentiation between complete and incomplete defects was made according to Han et al. 2016.

The study showed that defects of the LC were significantly larger in myopic eyes with primary open-angle glaucoma compared to myopic eyes without glaucoma ($p=0.0016$). Furthermore, there was a significant correlation with the reduction of the superior and inferior RNFL ($p=0.008$) and with the increase of mean deviation (MD) in perimetry ($p=0.007$).

In conclusion, defects of the LC were larger in myopic eyes with than without primary open-angle glaucoma and a more frequent occurrence of larger LC defects could be a risk factor for glaucoma in myopic eyes. The development of LC defects in the course of time is unclear and the appearance of new defects or an enlargement of existing ones may be caused by a progression of myopia or a progression of glaucoma.

Talk: “Evidence-based efficacy and adverse events of atropine eyedrops for the prevention of myopia progression in children” (G. Giannaccare)

The concept of atropine as a potential strategy to prevent myopia progression has over a 40-year history. First studies were conducted using atropine 1 % eyedrop in one eye while the fellow eye acted as control. A comparison between the effect of atropine 1 % and cyclopentolate 1 % on myopia was also performed, showing the superiority of atropine over cyclopentolate.

The exact mechanism of topical atropine is still unknown. It is thought that it might play a role in accommodative mechanism and might increase FGF-2 stimulation in a dose dependent manner thus resulting in less SF cell proliferation and axial elongation. Moreover, it might produce its effects by a massive and long-lasting increase in dopamine release from RPE.

There are many studies in literature showing the effects of high-dose (0.5 % or 1 %) vs low-dose (0.01 %) of atropine in terms of change in refractive error, axial length and side effects.

ATOM 1 was conducted as a placebo-controlled double-masked RCT. The study contemplated 2 years of treatment and 1 observational wash-out year. 400 children aged 6-12 years with myopia ranging from -1 to -6 D were enrolled. The treatment group received atropine 1 % in 1 eye while the control group received vehicle eye drops. The refractive error and axial length were found to have a similar trend. As a result, atropine was showed to slow down myopia progression in terms of increase in refractive error and axial length. However, once the atropine use was discontinued, a rebound effect appeared resulting in the progressive similarity between the two groups. Common side effect of atropine-use were pupil dilation, glare and loss of accommodation.

ATOM 2 was conducted as a double-masked RCT. The study contemplated 2 years of treatment and 1 year of treatment interruption. 400 children aged 6-12 years with a myopia $\geq -2D$ were enrolled. The subjects included in the study were randomized to bilateral treatment with atropine 0.5 % ($n=161$), 0.1 % ($n=155$) and 0.01 % ($n=84$). Atropine 0.01 % was found to have similar

efficacy to 0.1 %, 0.5 % and 1 %, but less side effects. In the second phase of the study, atropine use was stopped: children with a progression $\geq 0.50\text{D}$ restarted atropine 0.01 % for 24 months (phase 3). As described in the previous study, the interruption of treatment produced a rebound effect resulting in the progressive similarity between the patient and control groups. Restarting the therapy with atropine 0.01 % had the effect to reduce progression. On this basis, authors suggested atropine 0.01 % as the best therapeutic strategy, since it had the best therapeutic index, less side effects and less rebound phenomenon after treatment cessation.

Reported side effect were both systemic and ocular. Systemic side effects included dry mouth, face flush, headache, increased blood pressure, constipation and central nervous system disturbances while ocular side effects included photophobia, blurry near vision, local allergic response, all of which correlated with the concentration of atropine. The latest meta-analysis on efficacy and adverse effects of atropine (19 studies, 3137 children) suggests that the efficacy of atropine is dose independent within this range, whereas the adverse effects are dose dependent.

In conclusion, it can be stated that atropine 0.01 % provided the best results with negligible side effects, good tolerability and compliance. The possible myopic rebound after the suspension of the treatment and the duration of treatment represent open issues. Nevertheless, it is important to consider combined approaches (outdoor activities, Ortho-K, bifocals) which might better prevent the progression of myopia.

Talk “Slowing the progression of myopia with fractal contact lenses” (A. Hervás Ontiveros)

It is important to control myopia progression since high myopia ($>5\text{ D}$) significantly increases the risk of sight threatening conditions such glaucoma, retinal detachment, cataract and is now being recognised as a major cause of blindness. The risk of visual impairment is increased 3.4 times with myopia between 6 D and 10 D and 22 times when above 10 D.

In order to control myopia progression, it is important to know its main causes. Experimental studies in primates have shown that the development of the refractive state is regulated by the degree of retinal defocus: peripheral hypermetropic refractive error causes the myopia to increase. Thus, myopia might be stopped if a peripheral myopic blurring is created. Assuming that the peripheral retina has a role in myopia development and progression, new strategies are presented. One describes the use of fractal contact lenses (FCLs), where a fractal is a “fragmented geometric shape that can be subdivided into parts, which are, at least approximately, a reduced copy of the whole. The aim of the study was to assess the peripheral refraction induced by FCLs in myopic eyes by means of 2 dimensional relative peripheral error (RPE) map. The basic structure of the lenses is the Triadic Cantor. The lenses exhibit a double power: a far one and a therapeutic one.

A comparison between FCLs and a commercially available design (DF) was made: both exhibited a therapeutic power of 2D but FCLs were associated with larger relative peripheral myopic error whereas DF had a greater myopic effect in fovea. Moreover, FCLs had greater decentration tolerance than DF and total loss of DF lens efficacy was observed with decentring. The pilot test was conducted enrolling 26 myopic patients (mean age + SD 23.77 ± 3.62) with a refractive error of $-2.62 \pm 1.59D$ (astigmatism $< 0.75D$). The average decentring obtained was the following:

- Temporal 0.70 ± 0.19 mm (0.39 to 1.05 mm)
- Vertical 0.00 ± 0.49 mm (-0.64 to 1.38 mm)
- Polar 0.83 ± 0.27 mm @ $185 \pm 32^\circ$
- Pupil size 3.67 ± 0.53 mm

Even if the CL is decentred, the optical zone remains inside the pupil.

In conclusion, FCLs provide a greater myopic RPE than DF lenses, greater optical zone provides less affectation of foveal vision and decentration is less critical than in DF.

Talk “The approach to a child with High Myopia” (L. Van Lancker)

A clinical case of a 4 years old male with a myopia of -8 D and a vision acuity of 6/18 in both eyes was reported. The boy had a maternal grandfather with high myopia (-10 D) and a father with low myopia. There were no VA concerns or nyctalopia. The clinical examination revealed normal vitreous and fundi. Electrodiagnostic test showed a markedly subnormal Rod ERG, a subnormal photopic flicker, a normal but electronegative **a** wave of the cone bright flash ERG, an absent **b** wave and a delayed and reduced PERG P50. This implied generalised dysfunction involving rod and cone systems, which in turn implied the diagnosis of incomplete congenital stationary night blindness (CSNB). As a result, a main question was raised: Can we prevent myopia progression?

All studies and treatments to date are unfortunately conducted on simple low-moderate myopia, in children aged 6-12 years old, with not associated ocular abnormalities or genetic syndromes. Thus, it is not possible to generalize results to pre-school children or higher myopes.

The aforementioned myopic child tried atropine 0.01 % resulting in the non-progression of myopia at 6 months. On this basis, the approach to the highly myopic child should not take into account just the correction of refractive error, but it must be evaluating the presence of a syndrome or other systemic problems in order to ensure the best treatment options and to eventually provide educational support or additional healthcare. Moreover, the family may need genetic investigation and counselling for family planning. It is also important to know how common a syndrome is since 200 high myopia syndromes are listed in OMIM website. A study performed in 2001 on 112 children under 10 years old, with a myopia $>6D$ showed the presence of underlying systemic

problems in 54 % of cases, other ocular problems in 38 % and simple high myopia in 8 %. The ocular abnormalities found were mostly represented by anisometropia, amblyopia, strabismus, nystagmus, cataract, glaucoma, lens subluxation and ROP whereas systemic abnormalities were mostly represented by severe development delay, previous extreme prematurity, Stickler syndrome, Down syndrome, Marfan syndrome and ED syndrome. Thus, all highly myopic children should be seen by paediatrician and/or clinical genetics and the presence of ocular abnormalities or other systemic features must be investigated. The ophthalmologist should look closely at the lens, look carefully at the vitreous and think of CSNB if there is a boy with myopia and slightly subnormal vision. In addition, it is important to think about connective tissue disorders and bear in mind that Sticklers can have ocular-only phenotype if the disease affects gene exon 2.

Stickler syndrome is a hereditary progressive arthroophthalmopathy transmitted in an autosomic dominant way. Patients present with facial abnormality, hearing loss, cleft palate and joint problems. Stickler type 1 is very common with a membranous/empty vitreous phenotype. Stickler type 2 is only in 10-20 % of subjects with a beaded vitreous phenotype.

In summary, there is no evidence of myopia control treatments in high myopia to date and the presence of high myopia in young children implies the investigation of syndromes, a careful ocular examination, a paediatric/genetic counselling and an eventual educational support.

Round Table-Fighting Myopia Progression

C. Speeg-Schatz (France), L. Joachimsen (Germany), C. Cagini (Italy), W. Furlan (Spain), C. Hammond (UK)

Behaviour

1) Are there any annual myopia screening programs in your country?

- Incidence/prevalence statistics
- School visits – which age(s)
- Governmental
- Volunteers (IAPB, BMC, Lions/Rotary/Soroptimist, etc)

2) What is the age to choose for adolescent screening of myopia?

- Subjective for visual impairment
- Programmed (6y; 12y)

3) Does cost/benefit justify adolescent screening?

C. Cagini (Italy):

“We have no program for screening of myopia and we don’t know the exact prevalence of this problem in children. I think it’s very important to make a screening programme and prevent myopia progression since its incidence is increasing”

C. Speeg-Schatz (France):

“We don’t have any screening programme in France. Children are evaluated for visual acuity at 3,4,6,8 years old. Between the volunteers I don’t know any study about Lions or Rotary, but we have interest in industrial optics like Essilor which are interested in the numbers of myopia.”

W. Furlan (Spain):

“There’s no screening programme in Spain. The new-borns are seen by a physician and they are sent to an ophthalmologist in case something strange is noted. At 3 years old they have another visit and if they detect something strange, they will be sent to the ophthalmologist, but there’s not any screening programme”.

L. Joachimsen (Germany):

“We don’t have any myopia screening in Germany”

C. Hammond (UK):

“There’s no screening programme for myopia, but every child gets vision checked at the age of 4-5 when the school starts, basically to look for amblyopia rather than myopia, but clearly if they’ve reduced vision they will get referred. There was clearly no good reason to suggest a screening programme until we have an established treatment, but we have data that shows that about 12 % of children at 12 year old are myopic and 30 % of 18 year old are myopic, so we have prevalence data but not a screening programme”.

P.E. Gallenga (Italy):

“At this point there is a consensus about the fact that there is no reason to justify an adolescent screening for myopia”.

4) Information/training is given to teachers to recognize vision defects?

- Teach E of Albin or Snellen
- Evaluate PAC and distance
- Difficulty in reading
- Code of low vision behaviour

5) Recommendation to teachers/teaching direction-family for pc/mobile-internet use

- Interruption of accommodative effort in the time interval
- Lighting the school room

C. Speeg-Schatz (France):

“In France we don’t have any information for teachers, but we have books with general ideas about myopia and general public press or conferences”

L. Joachimsen (Germany)

“There’s no teaching for the teachers. Usually they just send children to the Ophthalmologist if they think a child has a problem of vision.”

C. Cagini (Italy):

“There’s no training for teachers. I think that some teachers are quite sensitized on this problem, so they are very careful in detecting any difficulty in reading or something like this.”

W. Furlan (Spain):

No information/training is given to teachers to recognize vision defects. In some schools, there are medical departments and usually a nurse who detects vision problems.

C. Hammond (UK):

“There’s no instruction to teachers. I think it will be a bit misleading to assume that they are going to do that. They report as I said earlier obvious concerns about a child who cannot see, but they will miss the amblyopes. I think it makes sense to expect the teachers to consider recommendation like interruption of accommodation or think about good lighting but expecting them to check vision I think is very difficult to achieve”.

P.E. Gallenga (Italy):

“We have a programme from 4 years now together with one of the wellness clubs to teach the teachers in the primary schools. I was able to find just in primary school children that were wearing glasses indicated from the teachers (not only for myopia, but also for amblyopia). Do you suggest that this could be a way to spread information about that? Can be useful?”

All “No”

P.E. Gallenga (Italy):

“Are there some indications to teach the teachers to make interruptions of accommodative effort during the school interval or to change the lighting of the school rooms?”

C. Speeg-Schatz (France):

“As I told before we don’t have any recommendation to teachers, but it would be interesting to speak about lighting in school rooms and to explain different ways of prevention like playing outside to be under light and not spending long time on electronic games or computers.”

L. Joachimsen (Germany)

“I think it’s quite important to look also if the windows are big enough so that enough light comes into the rooms. I read that in 1870 some schools were closed in Germany because they were too dark for children, so the problem is quite known.”

C. Cagini (Italy):

“I think it’s interesting to give some recommendation to teachers to stop accommodative effort and to do outdoor activities during the day.”

W. Furlan (Spain):

“I know that many doctors make these recommendations to teachers, but there is not an institutional recommendation.”

C. Hammond (UK):

“I don’t think there’s anything objective in checking vision by teachers; I think no recommendation makes sense until we understand really what’s going on.”

Prevention

1) which myopia?

- genetic/epigenetic factors?
- environment/educational factors?
- refraction/axial length?

C. Hammond (UK):

“The danger we have is the little evidence we got so far is all about older children: no study done has looked at children under 5 or under 4 yrs and this is probably the most important type of myopia we want to fight. I think there is a mixed bag of people with different syndromes and conditions and when we look at it, we really have to analyse them and see what the underlying causes are. Yes, it looks like the atropine is working, but we really need to bear in mind who we are dealing with and at what age we started because so far we don't know if anything is working in those who start atropine before the age of 4/5.”

P.E. Gallenga (Italy):

“Genetic factors mean that there are areas, maybe for an inbred situation where there are peaks of high myopia. There is an oasis in the centre of Sahara in which 95 % of people has high myopia (>7 D). In a problem like this what would be your suggestion for fighting myopia progression/diffusion?”

W. Furlan (Spain):

“According to the results of several studies, we see that there are several ways to fight against myopia progression. For my point of view, the alternative of soft multifocal lenses is interesting because it is safe and there are no side effects associated to the use of this kind of treatment. In Spain it's not very common for ophthalmologists to recommend the use of soft CL.”

C. Cagini (Italy):

“I think it's very difficult to fight the progression of high myopia in some populations because there's an important genetic component and we have few ways to fight its progression. We have just Atropine which is a good way, but it cannot be the resolution.”

L. Joachimsen (Germany)

“We have the experience to treat especially school myopia, but the genetic part of myopia is hard to treat.”

P.E. Gallenga (Italy):

“What's the best moment to fight myopia? During the primary school, secondary school, in teenage or adults? “I think as soon as possible, once you see that you have a progression of more 0.5 D each year”

C. Speeg-Schatz (France):

“I agree with the fact that we don't have any way to prevent genetic myopia, we have to advice parents if they have myopia to present their children very early. think epigenetic factors are very interesting actually and we have to explain to the parents the importance to do outdoor activities to stay under light and to avoid spending much time on computers and videogames. About refraction I think it's very important to do good refraction, good cycloplegia and to give full correction and not under-correction.”

P.E. Gallenga (Italy):

“There is still someone who suggests the use of under-correction, mainly the opticians who sometimes also change the prescription of the doctor. We all agree with the fact that myopia must be fully corrected.”

What methods of prevention?

- Eye drops (anti-muscarinic-pyrenzepine-atropine 0.01 % dosage, duration, side effects)
- environmental hygiene (outdoor activities-near work activities)
- spectacles/progressive additional lenses/contact lens/soft bifocal CL

- Ortho-K
- Palming (Bates method/bright sides exercises)
- Scleroplasty
- Food integration

Eye drops

C. Speeg-Schatz (France):

“When I see that myopia is increasing, I prescribe one eyedrop (atropine 0.01 %) before sleeping. We have about 100 patients under treatment.”

P.E. Gallenga (Italy):

“We would start with spectacles for correction and if there’s still a progression in myopia, we would start atropine 0.01 %.”

Carlo Cagini (Italy):

“We use atropine 0.01 % if myopia is going on, we use it for 2 yrs. We need to remember that this is an off-label method, but we can use it.”

W. Furlan (Spain):

“From my point of view soft bifocal contact lenses are one of the best options. FCLs are newly designed and have an improvement over the other kind of bifocal soft contact lenses specially designed to prevent myopia progression. FCLs have a larger central zone so that the eye has the ability to accommodate normally when the lens is put in and we have demonstrated theoretically and also experimentally that these lenses promote a higher PRE that is bigger than the one induced by other lenses on the market. The lens has a patent which is owned by the University of Valencia (Spain).”

M. Piovela (Italy): “If we provide a great damage due to the use of these devices (CL), there is no opportunity to escape the responsibility to be judged guilty (at least in Italy).”

C. Hammond (UK):

“We have a significant variability in patient’s characteristics and in the way treatments work. In my opinion it’s important to refer highly myopic children to a centre to put them in a study so that at the end we come up with useful data.”

Palming (Bates method/bright sides exercises) & Scleroplasty

F: I do not have any experience in palming nor scleroplasty.

G: Don’t know

I: Don’t know

S: Don’t know

UK: We should consider much safer treatment options since they are becoming available and are not involving major surgery.

P.E. Gallenga (Italy):

“It’s worth considering the assumption of Raviola and Prof. Balacco Gabrieli that there would be a cross-talk between the eye and the brain resulting in the possibility to have an increase in myopia as a response to this kind of relationship”

Food integration

G: No

F: Don't know

I: Don't know

S: Don't know

UK: There is no evidence

Conclusions:

In terms of refraction, atropine, pirenzepine and progressive addition spectacle lenses were effective. In terms of axial length, atropine, Ortho-K, peripheral defocus modifying CLs, pirenzepine, and progressive addition spectacle lenses were effective. The most effective interventions were pharmacologic, that is, muscarinic antagonists such as atropine and pirenzepine. Certain specially designed contact lenses, including Ortho-K and peripheral defocus modifying CLs, had moderate effects, whereas specially designed spectacle lenses showed minimal effects.