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Brief report

Initial assessment and follow-up of a myopic child: A clinical evaluation tool

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Abstract

Myopia comprises the leading cause of visual impairment in childhood, showing a global rapid rise in prevalence over the past years. Myopia progression has been related with a number of ocular complications potentially resulting in blindness, including glaucoma, macular degeneration, cataract, and retinal detachment. Etiopathogenesis of this disorder is regarded multifactorial, involving both environmental and genetic components. Near work activities are believed to play a key role in myopic development, owing to the induced hyperopic defocus on the peripheral retina that may result in axial elongation. Other parameters including outdoor exposure, physical activity and digital screen time are also hypothesized to be connected with myopic development. Ocular examination of myopic subjects should include visual acuity assessment, refraction, biometry and choroidal thickness measurements, as well as evaluation of the accommodative functions. We propose a clinical assessment tool, as a useful guide for all eye care professionals examining and treating juvenile myopes.

Key words: myopia; childhood; risk factors; near work; clinical examination; clinical assessment tool

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Text

Myopia constitutes a common visual disorder, which is characterized by a perceived blurred image of distance objects. In recent years, myopia prevalence has shown a global rising trend (Holden et al., 2016) An increasing number of near-sighted school-aged children and adolescents is examined in outpatient and emergency ophthalmic services. Proper follow-up and treatment of juvenile myopes is of great importance, as myopic progression has been associated with long-term complications that could result in blindness, including glaucoma, macular degeneration, cataract, and retinal detachment (Prousali et al., 2019) Also, early-onset myopia is strongly connected with development of high myopia in adulthood (Liang et al., 2004; French et al., 2013)

The nature of myopia is considered multifactorial. Environmental parameters are believed to play a predominant role in myopic development, and presumably interact with a genetic predisposition. Modern lifestyle, including a higher educational load and increased digital screen time, is probably implicated in the ongoing myopia epidemic. Near work activities are currently regarded as a main factor leading to myopia. Optical defocus is believed to induce alterations in ocular growth and, hence, influence the emmetropization process. Prolonged near work produces a hyperopic defocus on the peripheral retina, which is associated with an increased accommodative demand. A perceived blurred image due to a higher accommodative lag is presumed to trigger axial elongation and lead to myopic development (Gwiazda et al., 1993; Woodman et al., 2011; Huang, Chang and Wu, 2015)

The cycloplegic spherical equivalent refractive error is regarded as the prevalent predicting factor for myopia onset, with 6-year-old children with a refraction of +0.75D or less recognized as being at risk (Zadnik et al., 2015) As shown by a number of studies, Asian ethnicity represents a risk factor for pediatric myopia (French et al., 2013; Theophanous et al., 2018) Also, the presence of parental myopia and the number of myopic parents, as well as low birth weight, have been identified as independent risk factors associated with myopia, and probably with high myopia development.(Liang et al., 2004; Fieß et al., 2019; Tideman et al., 2019; McCrann et al., 2020) In addition, increased time spent outdoors has been reported to prevent myopic development, but does not appear to affect already myopic eyes.(Xiong et al., 2017) Increased reading time and lower physical activity have also been implicated as risk factors.(Theophanous et al., 2018; Tideman et al., 2019) Another interesting parameter is the digital screen time, with inconsistent findings among existing studies. Of note, as Lanca and Saw underline in their systematic review, the myopia epidemic appears to have begun before the use of digital devices reached huge proportions, thus may reasonably be mainly associated with educational purposes.(Lanca and Saw, 2020)

Several treatments have been explored for limiting myopia progression. Interventions including bifocal lenses, rigid gas permeable contact lenses, progressive addition lenses and soft contact lenses have shown restricted or no efficacy in slowing myopic development. The effect of undercorrection compared to full correction remains contentious, and further relevant research is warranted. In recent years, myopia research has been targeted mainly towards atropine eye drops, orthokeratology lenses and multifocal contact lenses, which appear to be the prevalent effective options. Atropine comprises a non-selective muscarinic acetylcholine receptor antagonist, which seems to cause relaxation of accommodation and possibly impact on the retina and sclera. Orthokeratology is presumed to act by compensating for the relative hyperopic peripheral defocus. Latest studies have reported favorable outcomes for several types of multifocal lenses, which consist of different zones that gradually become positive towards the periphery.(Prousali et al., 2017, 2019)

The majority of current protocols for assessment of myopic progression involve the changes in refractive error and in axial length between visits as the main outcome measures. Notably, myopic development has been associated with additional parameters. Latest evidence has shown that choroidal thickness is progressively declining as myopia rises.(Efthymia Prousali et al., 2021) Also, dynamic accommodative parameters, including the accommodative accuracy, amplitude and facility, appear to demonstrate alterations with myopia progression.(Wolffsohn et al., 2019) A number of studies have reported a reduction of accommodative facility and increase of amplitude with increasing myopia.(O'Leary and Allen, 2001; Pandian et al., 2006; Radhakrishnan, Allen and Charman, 2007; Bernal-Molina et al., 2016; Wagner, Zrenner and Strasser, 2019) Although it has been suggested that accommodative lag could predict myopic development, this association has not been confirmed by all relevant existing studies.(Allen and O'Leary, 2006) It is also uncertain whether changes in accommodative accuracy precede or follow myopia onset. Of note, accommodative convergence to accommodation (AC/A) ratio has shown an increasing trend preceding myopic development, thus further investigation of this parameter could be clinically significant.(Mutti et al., 2017) In addition, an effect of pupil size on myopic development has been hypothesized, with myopes appearing to have larger pupils that may explain retinal blur, but this assumption has not been confirmed to date. (Charman and Radhakrishnan, 2009; Wolffsohn et al., 2019)

Based on existing knowledge, we hereby summarize patient characteristics and outcomes that may be assessed in initial and follow-up visits of pediatric myopic subjects, and propose a clinical assessment tool (Table 1). Ocular biometry should include axial length, keratometry readings and anterior chamber depth measurements. If indicated, anterior segment optical coherence tomography (AS-OCT) may be performed, providing additional information on corneal thickness, iridocorneal angle and lens thickness. Fundoscopy may be supplemented by fundus photography and OCT involving the macular area, if needed. Of note, reliable choroidal thickness measurements should preferably be obtained prior to cycloplegia.(E Prousali et al., 2021; Efthymia Prousali et al., 2021) Treatment with atropine eye drops has been connected with adverse reactions including blurred near vision, photophobia and rebound effect. Also, orthokeratology has been associated with an increased risk for microbial keratitis (Prousali et al., 2019). Patients and patients' guardians should be instructed to immediately report any adverse event. In addition, atropine exerts an effect on the accommodative response and pupil size, thus interpretation of these parameters after treatment should be made cautiously. Overall, we present the baseline characteristics and components of ocular examination of a myopic child, as a useful tool for all eye care professionals that increasingly examine and treat young myopes.

Table 1. Baseline characteristics & follow-up assessment

Baseline characteristics	Follow-up assessment
1. Patient ID	1. Best-corrected visual acuity for distance
2. Age	2. Best-corrected visual acuity for near
3. Sex	3. Non-cycloplegic autorefraction
4. Weight	4. Cover test
5. Height	5. Biometry
6. Age of myopia onset	6. Choroidal thickness
7. Age of first prescription of treatment	7. Pupillometry
8. Dominant eye	8. Accommodative amplitude
9. Gestational age	9. Accommodative accuracy
10. Birth weight	10. Accommodative facility
11. Presence of paternal myopia	11. Autorefraction post-cycloplegia
12. Presence of maternal myopia	12. Fundoscopy
13. Time spent on near work activities	13. Customized questionnaire assessing patient satisfaction on intervention used
14. Reading distance	
15. Time spent on sport activities	
16. Outdoor exposure	

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