Case Report
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Optometry meets ophthalmology- cycloplegic refraction and examination under general anaesthesia in a paediatric high myope

Abstract

Purpose: To discuss a case of shared optometric-ophthalmic (O-O) approach in objectively refracting and examining a paediatric high myope under general anaesthesia.

Methods: A paediatric high myope was cyclopleged then underwent objective retinoscopy under general anaesthesia within a surgical theatre setting. Corneal diameter, interpupillary distance, immersion biometry axial lengths, intraocular pressures, keratometry readings, A-scan and B-scan ultrasound images were all subsequently obtained. Lastly, binocular indirect ophthalmoscopic examination with 360º scleral indentation was carried out. A comprehensive O-O report was dispensed with all collated parameters.

Results: A refractive error of -11.00DS bilaterally was measured. Ocular health assessment showed no significant myopic abnormalities. The patient was dispensed spectacles and adapted well with improved comfort. Low dose atropine myopia control was commenced.

Conclusion: O-O shared care in refracting and examining difficult and highly myopic paediatric cases under general anaesthesia is a useful and effective tool.

Keywords: paediatric, high myopia, pathological myopia, general anaesthesia, objective retinoscopy, myopia control

Volume 13 Issue 1 - 2023

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Received: January 28, 2023 | **Published:** February 09, 2023

Introduction

Refractive error can be defined as an ocular disorder characterized by light rays entering the eye not being focused onto the macula for visual processing. World Health Organization (WHO) estimates that 123.7 million people worldwide are living with some form of uncorrected refractive error. Myopia, the most common type, also known as short sightedness, occurs when light rays that enter the eye are focused anteriorly to the macula causing distance vision to be blurred. WHO estimates that approximately half of the world's population will be myopic by 2050.[1] Within recent times, there has been a rampant increase in myopia progression, mainly in children aged 6-8 years old. A significant reason for this is the Covid-19 pandemic's resultant decrease in children's time spent outdoors and inverse increase in time spent on near devices.[2] Myopia may be categorized as follows: 0 to -1.5D (mild), -1.5D to -6.0D (moderate) and >-6.0D (high,) or according to its underlying pathogenesis: increased curvature of the cornea or lens (curvature myopia,) increased lens refractive index (index myopia,) accommodative spasms or excessive accommodating (accommodative myopia.).[3]

With either type, progression causes the risk of developing ocular pathology to augment. Myopic macular degeneration can cause irreversible loss of central vision and is one of the leading causes of blindness.[4] Based on the literature, even the risk of developing glaucoma increased by 50% with high myopes. Cataracts requiring surgery is also increased by 17% in high myopes. The risk of developing retinal tears and detachments is amplified by 5 to 6 times with high myopes.[5] Besides this, there are several other pathological findings which can occur, and thus overall, there is sufficient rationale in attempting to slow myopic progression from early childhood.

Axial Length myopia is the one of the more common types of myopia found amongst children. Progression of myopia is typical at first, but until school age, when there is a significant myopic shift that can progress until late teenage years.[6] The average emmetrope between the ages of 4 to 16 years has an average axial length of 23.19mm +/1 0.01mm.[7] As axial length increases, the magnitude of myopia also increases. Axial lengths can be measured using different methods, namely with non-contact optical interferometry or contact immersion ultrasound biometry.

Although the axial length measurement can give an estimate into to the type and magnitude of refractive error, a cycloplegic refraction still remains the gold standard, especially in the paediatric population. Cycloplegic examination involves the use of a muscarinic antagonist which paralyzes the ciliary muscles, thereby ceasing accommodation. Topical cyclopentolate 1% is widely used amongst eye care practitioners due to its relatively short duration of action and fewer side effects when compared to other cycloplegics. If accommodation is left uncontrolled during refractive testing, myopia can be over-corrected whereas hyperopia can be under-corrected.[8] After cycloplegia is achieved, with cooperative patients, objective retinoscopy is done to obtain the spectacle prescription followed by ophthalmoscopy and slit lamp examination to assess ocular health.

Certain paediatric cases, although infrequent, may warrant the introduction of performing objective retinoscopy under GA. Scenarios such as subjective difficulty with charts, poor testing cooperation, non-organic visual impairment refractions, physically/ developmentally impaired patients, and those with co-existing ophthalmic pathology, are candidates more safely suited for refractive testing under general anaesthesia (GA). This would allow simultaneous ocular examination under the operating microscope, with possible scope for auxiliary management by the ophthalmologist.

The case described in this paper exemplifies this O-O shared care approach adopted by our hospital, in the assessment of difficult paediatric cases. In our literature search, we found that this method

has been reported in solely paediatric glaucoma assessment/refractive cases. We hope to bridge the gap in the literature and reveal that this method can be additionally be useful in difficult/ highly myopic/ special needs cases as well moving forward.

Case presentation

A 7-year-old male child of East Indian descent at Standard II primary school level, was brought in by his parents for an eye examination after repeatedly throwing off his spectacles and refusing to wear them. This problem started around one (1) month prior and was ongoing. The parents also noted that the child will hold his devices extremely close to him for viewing. There was no significant medical history, and notably, no reporting of floaters, flashes, peripheral vision curtain defects, history of trauma, family history of retinal detachment, family history of myopia, family history of blindness, and family history of squint. His approximated daily hours of near work were six vs one of outdoor activity on average. His specs at the time were four (4) years old, prescribed by another external optometrist faced with similar difficult examination. Due to constant closing of eyes and bodily movements, the optometrist was unable to perform an ocular health assessment and any form of refractive testing (automated, subjective and objective.) The patient was rescheduled for re-trial of testing on another day, but at this follow up visit, the same difficulties ensued. A mutual decision was then made by the hospital's ophthalmologist and optometrist to have the child examined and refracted under GA in theatre.

On the day of examination, the medical team comprised of our ophthalmologists, anesthesiologist and optometrist. The process began by administration of topical cyclopentolate 1% drops with proparacaine anesthetic at 20-minute intervals until pupils were maximally dilated and no accommodative response was observed. The anaesthesiologist and supporting nursing staff then set the patient to lie in a supine position on the theatre bed. Supervised sedation under ketamine was then achieved. A speculum was placed to keep the lids retracted for examination, then the optometrist initiated work up with darkened room retinoscopy with trial lenses and a handheld axis protractor, as shown in Figure 1A & 1B. A stable working distance (WD) was maintained throughout retinoscopy and therefore, used to correct the gross result subsequently. To ensure stability and reliability in the refraction obtained, the refraction was dually performed by the ophthalmologist, to compare closeness of values.

After conducting the refractive portion, tropicamide 1% drops were instilled to maintain maximal dilation of the pupils. The ophthalmologist successively examined both eyes under the operating microscope. The corneal diameter (CD) and interpupillary diameter (IPD) were measured, contact immersion biometry performed, intraocular pressure (IOP) and keratometry measured. A & B-scan ultrasounds scan were then done to assess for axial lengths and posterior staphylomas respectively. Lastly, meticulous binocular indirect ophthalmoscopic examination was done with 360º scleral indentation. A full O-O report was created, as shown in Figures 2A–2C and Figures 3A – 3B with all collated parameters and uploaded to the computerized hospital database. The patient was awakened after the procedure and remained on the post-operative surgical ward for two (2) hours of post-procedural anaesthesiologist monitoring before leaving.

The patient was seen back at the hospital's Optical two (2) weeks later, where specs were fitted and dispensed. A specs adaptation period of two (2) weeks were allowed and the patient followed up thereafter with the optometrist. At the visit, the parents reported marked observable changes in their son's behavioral patterns. The patient was no longer throwing any frustration tantrums, and was more willing to be approached and have testing done. The patient was keen on keeping on the spectacles constantly, and refused to have them removed. The patient was also found to be holding his near devices and books at a farther distance than before. He was more observant and attentive to his environment with his new specs.

Figure 1A Darkened room objective retinoscopy of a supine paediatric patient under general anaesthesia, showing a maintained working distance.

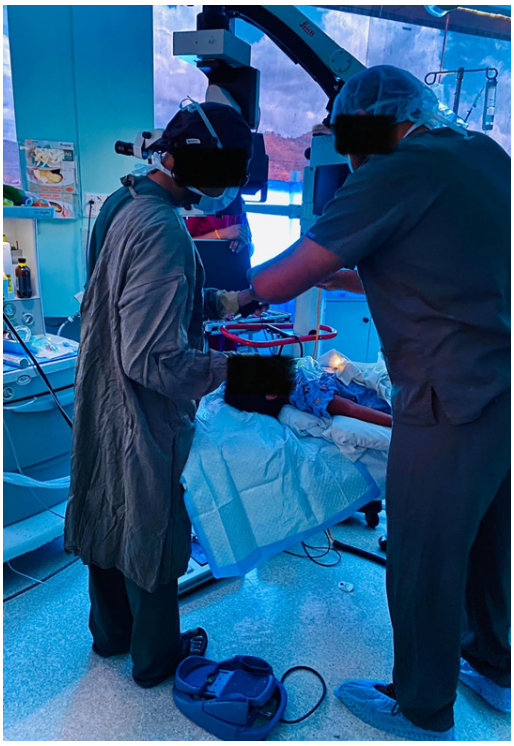

Figure 1B Dual examination by the optometrist and ophthalmologist.

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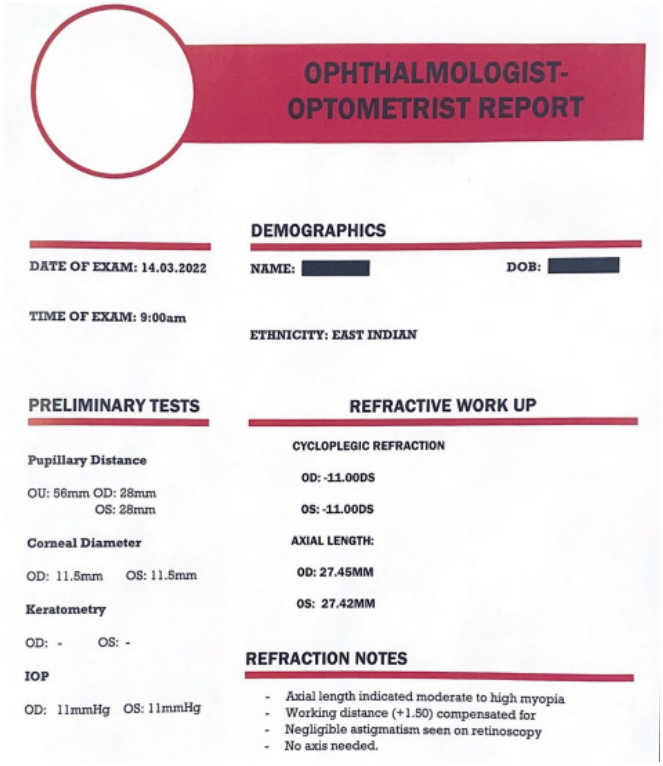


OPHTHALMOLOGIST- OPTOMETRIST REPORT

DEMOGRAPHICS

DATE OF EXAM: 14.03.2022

NAME: [redacted] DOB: [redacted]

TIME OF EXAM: 9:00am

ETHNICITY: EAST INDIAN

PRELIMINARY TESTS

Pupillary Distance

OU: 56mm OD: 28mm
OS: 28mm

Corneal Diameter

OD: 11.5mm OS: 11.5mm

Keratometry

OD: - OS: -

IOP

OD: 11mmHg OS: 11mmHg

REFRACTIVE WORK UP

CYCLOPLEGIC REFRACTION

OD: -11.00DS

OS: -11.00DS

AXIAL LENGTH:

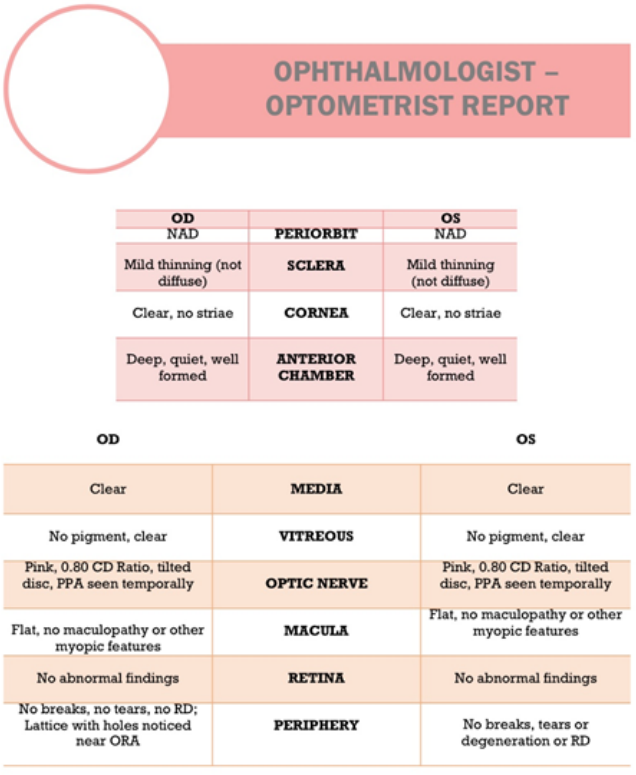
OD: 27.45MM

OS: 27.42MM

REFRACTION NOTES

- Axial length indicated moderate to high myopia
- Working distance (+1.50) compensated for
- Negligible astigmatism seen on retinoscopy
- No axis needed.

Figure 2A O-O report showing examined refractive results.

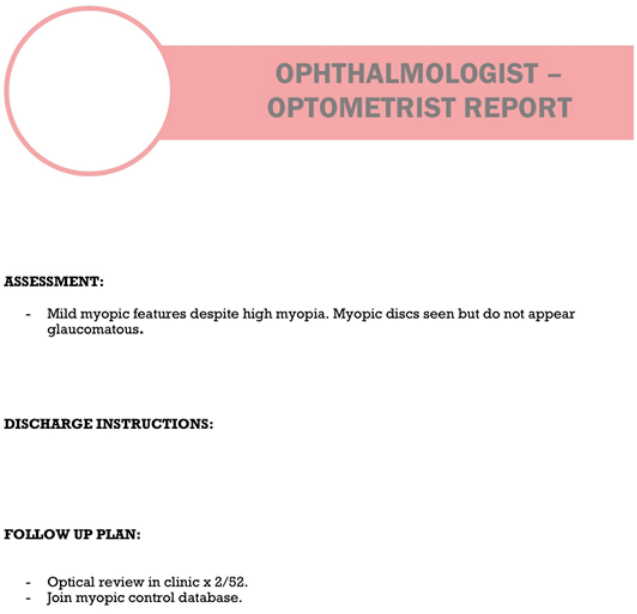


OPHTHALMOLOGIST – OPTOMETRIST REPORT

OD		OS
NAD	PERIORBIT	NAD
Mild thinning (not diffuse)	SCLERA	Mild thinning (not diffuse)
Clear, no striae	CORNEA	Clear, no striae
Deep, quiet, well formed	ANTERIOR CHAMBER	Deep, quiet, well formed

OD		OS
Clear	MEDIA	Clear
No pigment, clear	VITREOUS	No pigment, clear
Pink, 0.80 CD Ratio, tilted disc, PPA seen temporally	OPTIC NERVE	Pink, 0.80 CD Ratio, tilted disc, PPA seen temporally
Flat, no maculopathy or other myopic features	MACULA	Flat, no maculopathy or other myopic features
No abnormal findings	RETINA	No abnormal findings
No breaks, no tears, no RD; Lattice with holes noticed near ORA	PERIPHERY	No breaks, tears or degeneration or RD

Figure 2B O-O report showing examined ocular health findings.



OPHTHALMOLOGIST – OPTOMETRIST REPORT

ASSESSMENT:

- Mild myopic features despite high myopia. Myopic discs seen but do not appear glaucomatous.

DISCHARGE INSTRUCTIONS:

FOLLOW UP PLAN:

- Optical review in clinic x 2/52.
- Join myopic control database.

Figure 2C O-O report showing assessment and follow up plans.

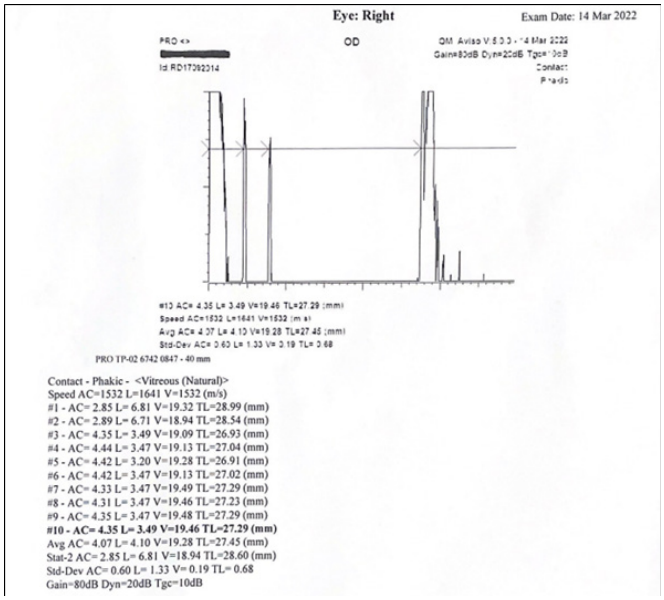


Figure 3A Contact A-scan Ultrasound Biometry OD results.

Discussion

Myopia is defined as an anomalous refractive state whereby the eye focuses light from a distance in front of the retina.[9] This report focuses on a case of paediatric axial myopia in particular. There are no precise estimates of the global prevalence or for projected temporal changes over the next few decades; however, it is still recognized that overall, uncorrected refractive error accounts for globally, the most common cause of visual impairment and second most common cause of blindness. Furthermore, there is variation among ethnic groups and regions, but generally is on the increase worldwide.[10]

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Physiological myopia is usually < 2D and appears to be associated with increased time spent doing near work (e.g. reading,) through childhood into early adulthood. On the other hand, pathological myopia (less common,) is defined as enlargement of the globe with lengthening of the posterior segment and is associated with higher levels of myopia (>-6D.)[9] As such, the general principle of myopia control is early recognition of childhood myopia with attempted slowing of progression into this pathological state. This brings to light the role of primary ophthalmic-optometric (O-O) shared care within the community.

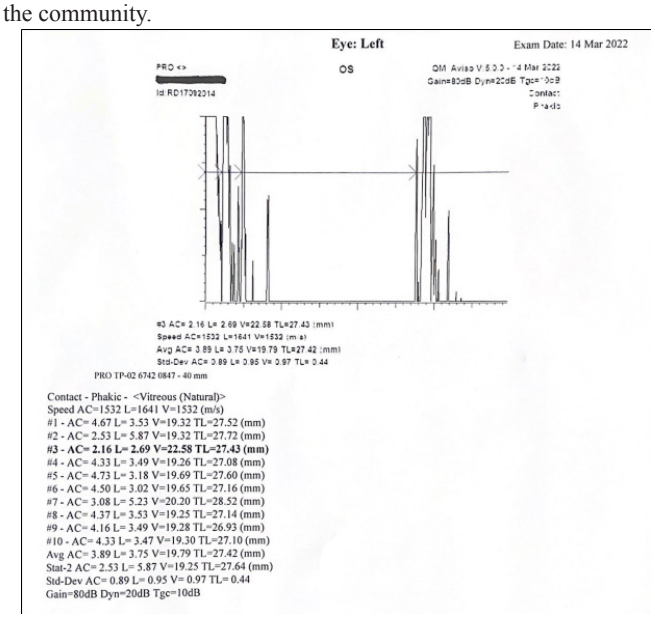

Figure 3B Contact ultrasound biometry OS results.

The acquisition of a reliably accurate refraction in a paediatric patient carries significant importance. This not only ensures patient comfort and reduction of asthenopia, but also allows for more accurate tracking of myopic progression comparative to corresponding age and axial length change. Objective cycloplegic refraction is highly recommended as it is more sensitive than subjective refraction error in all age groups, especially in children and young adults.[10] The main purpose of cycloplegia is aimed at reducing the accommodative efforts of the eye. Moreover, the added benefit of using this objective method is the avoidance of subjective difficulty with charts, poor testing cooperation, and non-organic visual impairment refractions. Even with these simplifying measures, objective retinoscopy can still prove to be a task in the physically impaired, the developmentally impaired, those with co-existing ophthalmic pathology, and healthy children without pathology. Therein lies the concept of the refractionist performing objective retinoscopy under GA, with ophthalmologist co-support. It supports simple examination of the anterior and posterior segments under the operating microscope, and binocular indirect ophthalmoscopy with scleral indentation. The latter is crucial in identifying myopic fundus features such as peripheral retinal degenerations (most commonly lattice type,) tears, breaks, and rhegmatogenous retinal detachments. Detecting these features clinically, especially as far as the ora serrata, in some paediatric patients can sometimes be exceptionally challenging, time-consuming and uncomfortable. With intra-theatre diagnosis, treatment can be done concomitantly (e.g. laser photocoagulation, cryotherapy etc.) Additionally, clinical testing requiring close contact, e.g. corneal diameter (CD) measurement, interpupillary distance (IPD) measurement, biometry, pachymetry central corneal thickness (CCT,) and intraocular pressure (IOP) measurement can be done. The latter advantage steers away from the incidence of elevated IOPs with crying and squinting eyes during IOP measurements.[11]

At our hospital, the Trinidad Eye Hospital | Caribbean Vitreous and Retina Surgery Ltd. (TEH | CVRS,) our in-house optometrist adopts a systematic approach as follows, in assessing a paediatric high myope deemed at risk for pathological progression. Routinely and generally to begin with, an automated refractor (AR) is used to estimate the patient's refractive error. With any flag of childhood myopia, this prompts supplementation of the routine history and exam with further in-depth assessment for myopic features. Careful enquiry about floaters, flashes, peripheral vision curtain defects, approximated daily hours of near work vs outdoor activity, level in school system, history of trauma, family history of retinal detachment, family history of myopia, family history of blindness, and family history of squint is done. The patient's WD is also noted. After history acquisition, the patient is cyclopleged as described previously. The AR is used as a guiding start point for the objective retinoscopy. In the event of non-definitive, ambiguous refraction, or in the aforementioned clinical circumstances precluding reliable refraction, these patients are re-routed for booking of objective retinoscopy and examination under GA in the surgical theatre. Informed consent is obtained, then our anaesthesiologist provides medical clearance for the patient in question. Of note, our choice of GA is ketamine due to its safety profile in the paediatric population. It also does not contribute to significant alterations in IOPs under sedation.[11–13]

On the theatre day, the patient is topically anaesthetized and cyclopleged as described before the proposed start time of examination. The anaesthesiologist and supporting nursing staff then set the patient to lie in a supine position on the theatre bed. Sedation under ketamine is then achieved. A speculum is placed to supervised the lids retracted for examination, then the optometrist initiates work up with darkened room retinoscopy with trial lenses and handheld axis protractor, as shown in Figure 1A. A stable WD is maintained throughout retinoscopy and therefore, used to correct the gross result subsequently. To ensure stability and reliability in the refraction obtained, the refraction is dually performed by the ophthalmologist, to compare closeness of values. After conducting the refractive portion, tropicamide 1% drops are instilled to maintain maximal dilation of the pupils. The consultant ophthalmologist successively examines both eyes under the operating microscope. The CD and IPD are measured, immersion biometry performed, IOP, keratometry and CCT measured. A and B-scan ultrasounds are then done to assess for axial lengths and posterior staphyloma respectively. Lastly, meticulous binocular indirect ophthalmoscopic examination is done with 360º scleral indentation to search for peripheral findings as previously denoted. To note, other pathological myopic fundus features which may be seen and therefore they are searched for, include chorioretinal atrophy, tessellated fundal appearance, lacquer cracks (breaks in Bruch's membrane,) choroidal neovascular membrane (CNVM) sequelae (macular haemorrhage, Förster-Fuch's spots,) tilted discs, peripapillary choroidal cavitation, vitreous syneresis, posterior vitreous detachment, and zonular dehiscence.[9] All of the above examination techniques and tests are done specifically in this chronological order to reduce the likelihood of AP pressure on the globe surface, which can potentiate falsely low axial lengths, keratometry readings and corneal astigmatism.

A full O-O report is created with all collated parameters. (Figures 2A & 2B) and Figures 3A – 3B accessible on a computerized database mutual to both the optical and ophthalmic portions of the hospital. The patient is awakened after the procedure and monitored by the anaesthesiologist on the post-operative surgical ward for two (2) hours before leaving.

The patient is scheduled to follow up at the hospital's Optical two (2) weeks later, where specs are fitted and dispensed. Following an average adaptation period of two (2) weeks, the patient is followed up at the Optical. At this visit, the optometrist enquires about asthenopic symptoms, behavioural patterns, balancing while walking down steps, fix and compliance with specs wear. Should any issues arise, or in the event of identified ocular pathology, the patient is re-routed adjacent the main ophthalmic clinic for further workup by the opthalmologist. The case we described demonstrated that in a difficult paediatric myopic refraction, reliable objective retinoscopy and examination under GA can provide a comfortably accurate refraction result for initiation of myopia control. The patient initially exhibited symptoms of discordance with his pre-existing specs but with post-procedural refractive correction, the patient was observably more compliant and at ease with his specs. At a refractive status of -11.0D, this probed the decision to quickly commence myopia control with low dose atropine drops from hereonafter. In fact, although not offered at our hospital's optical, the parameters obtained in our O-O report can potentiate consideration of many other myopia control options, such as overnight Ortho-keratology, bifocal lenses, progressive lenses, and peripheral defocusing soft contact lenses, should the primary atropine route fail.[14] Since ketamine[15] is simple, and relatively low risk, with respect to cardiovascular, respiratory, oculocardiac reflex, analgesic, and antimetic considerations,[16] O-O assessment clock minutes GA also spent under repeated cycloplegic refractions and examinations under general anaesthesia at proposed intervals of one (1) year to track progress of administered myopia control would be carried out. Reduces with subsequent bookings since some parameters will stabilize age (for example IPD and CD). During these one year refraction intervals however, optometric assessments will still be regularly scheduled. A tremendous benefit of this described O-O shared care hospital system in paediatric atropine myopia control means that the long-term use of atropine with its potential side effect profile can be monitored and managed safely and expeditiously.[17]

In our literature search, this technique of examination under GA with and without cycloplegic refraction has been described, but more evidently so in paediatric glaucoma patients.[18] There appears to be a gap in the literature, in using this said technique in high myopes. In light of this, we propose this as a possible novel method of refracting suitable subgroups of childhood high myopes and other difficult paediatric refractions, as elaborated on above. Understandably however, this means that this protocol is best suited in an optical setting which has the hospital ready support of an ophthalmologist and anaesthesiologist. Certainly, more research is required in this area to substantiate our position, especially with higher stance in the hierarchy pyramid of Evidence Based Medicine. Additionally, studies with larger subject pool numbers and investigation into long term systemic effects of repeated paediatric sedations would need to be reported on. In conclusion, the shared O-O practice of examining and refracting a high myope holistically pre-initiation of myopia control can be effectively worthwhile.

Acknowledgments

None.

Conflicts of interest

The author declares that there are no conflicts of interest.

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