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3D CT image shows fracture of C7 right lateral mass and C6-7subluxation.
(Refer to pages 489-493)

E d i t o r i a l

The future is near: focus on myopia

D T H Tan

Myopia, or shortsightedness, is an optical aberration of the eye whereby objects at a distance are not focused onto the retina, but are brought to a focus in front of the retina, resulting in a blurred image. Individuals with myopia are able to see near objects clearly, but distant objects are blurred. Various optical solutions include the use of spectacles and contact lenses to bring the image in focus on the retina. With the advent of the excimer laser, refractive surgical procedures such as LASIK (laser-assisted in-situ keratomileusis) are now able to accurately reshape the cornea to correct the optical state of the myopic eye. LASIK is now the second commonest eye operation in Singapore, and recent media interest in this largely cosmetic procedure belies the impact of myopia on our population.

Why the obsession on myopia? Simply put, myopia is the most prevalent ocular disorder globally, myopia is on the rise and reaching epidemic proportions, and Singapore has the dubious reputation of having the highest prevalence in the world. Whereas the prevalence of myopia in the United States is estimated to be 25%, and the prevalence in India to be 19%, in the Asian cities of Singapore, Hong Kong and Taiwan, prevalence rates of myopia are considerably higher[1,2]. A study of 4,000 Taiwanese schoolchildren revealed myopia prevalences to be 40% at age 12 years, and 70% at age 15 years[3]. Local researchers from the Singapore Eye Research Institute (SERI) and the Department of Community, Occupational and Family Medicine (COFM) Department of the Faculty of Medicine at National University of Singapore have been documenting myopia progression in 1979 schoolchildren from three primary schools since 1999 in a longitudinal cohort study known as the Singapore Cohort Study of the Risk Factors of Myopia (SCORM)[4]. The prevalence of myopia (defined as <0.5 dioptres (50 degrees) in SCORM children was 27.8% at age seven years, 34.5% at age eight years and 43.4% at age nine years.

In a study of 15,068 Singapore military recruits aged 16 to 25 years, the prevalence rates of myopia were highest in Chinese (82.2%), followed by Indians (68.8%) and Malays (65.0%), suggesting a possible common environmental influence in Singapore affecting all three races[5]. These startling statistics now culminate in Woo et al's study in this issue of the Singapore Medical Journal (SMJ), which reveals a new high in the prevalence rate of myopia in local medical students[6]. Of the 157 second year medical students (aged 19-23 years), an astonishing 89.8% were myopic, a higher percentage than the 82% reported by an earlier study on medical students in a 1990 SMJ article[7].

It is, therefore, not surprising that myopia is considered to be a major ophthalmic public health issue, and much eye research in Singapore is

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focused on myopia. The logo of the SERI is a diagrammatic representation of a myopic eye, and SERI, the national body for ophthalmic and vision research representing multi-institutional eye research locally, has major epidemiological, clinical and basic laboratory research programs in myopia. The Ministry of Health has opted to track the problem of myopia within the scope of its national disease registries in the form of the Singapore Myopia Registry (SMR), which aims to provide island-wide data of all primary and secondary schoolchildren at a national level. The Health Promotion Board's National Myopia Prevention Program (NMPP) currently attempts to reduce myopia onset and progression through structured school and population-based intervention programs.

What is the cause of the rapid rise in myopia prevalences, and why Singapore? Is myopia a genetic or environmental issue? This "nature-nurture" question has been debated at length by myopia researchers, and although evidence is still sadly lacking, it is likely that both genetic and environmental factors play some role. Genetic studies conducted by SERI and the Defense Medical and Epidemiological Research Institute on myopia are still in progress. The SCORM study evaluated many various environmental and genetic risk factors for myopia progression, including the parental history of myopia in the study children, socioeconomic status, IQ and academic achievement, anthropometric measurements, and night-time lighting. The most revealing risk factor that emerged was the association with near-work activities, which include reading, writing, computer usage and playing video games[8-18]. Saw et al reported that the percentage of moderate to high myopia in children with no parental history of myopia, and who read two or fewer books a week, was only 2.5%, as compared to 23.7% in children with two myopic parents and who read more than two books per week – an almost 10-fold difference[9].

Despite being a common problem, myopia is often thought of as a condition of low ocular morbidity, as simple solutions such as spectacles can correct refractive errors with ease. However, the degree and severity of myopia is also on the rise, and high myopia (at least -6.0 dioptres) has been clearly shown to be associated with potentially blinding disorders such as retinal detachment, myopic macular degeneration, glaucoma, and cataract[19]. Local blindness registry data, although fraught with bias, reports that myopia is the fourth leading cause of blindness in Singapore, and world blindness data from World Health Organisation (WHO) report and confirm that uncorrected refractive error remains the second commonest cause of global visual impairment after cataract[20]. Interestingly, although not directly pertaining to myopia, epidemiological studies have shown that even mild forms of visual impairment (<6/12 visual acuity) can result in significant morbidity (twice the risk of falls, four times the risk of hip fractures, three times the risk of mental depression), and even a 2.5 times higher mortality[21-24].

The socioeconomic impact of myopia in Singapore is also significant. From the military standpoint, over 80% of our enlisted national servicemen are myopic, and almost 20% of potential pilot applicants for the Republic of Singapore Air Force are rejected because of refractive errors[25]. Economically, the optical trade is a significant market in Singapore. In 1998, there were 816 optical outlets locally, and myopic Singaporeans have been estimated to spend US$90 million annually on

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spectacles[25]. Contact lens wear is the main risk factor for infectious corneal ulcers in Singapore, and about 800 contact lens complications are seen yearly in public hospital eye departments (Lim Li, unpublished data, 2003). Despite improvements in contact lens designs, infections still occur with the latest disposable soft contact lenses, and Su et al recently reported on two local cases of severe infectious corneal ulcers with these new lenses[26].

Of importance are reports of infections occurring in children fitted with orthokeratology contact lenses. Orthokeratology (OK) is a form of programmed contact lens wear designed to alter the shape of the cornea with overnight lens wear so as to enable good vision without optical correction during the day in low myopes. Despite a distinct lack of scientific evidence, OK practitioners are encouraging the use of orthokeratology in young children in an attempt to reduce myopia progression. Wang and Li recently published a case report of a local 14-year-old girl who developed a severe Pseudomonas corneal ulcer from overnight wear of OK lenses[27].

Myopia represents abnormal growth in the axial length of the eyeball, and Beuerman and co-workers at our SERI laboratory have developed a mouse model of myopia, allowing the use of DNA microarray studies to work toward understanding gene regulation in myopia.

What, then, lies on the horizon? Can the tide of myopia progression be stemmed? Myopia represents abnormal growth in the axial length of the eyeball, and Beuerman and co-workers at our SERI laboratory have developed a mouse model of myopia, allowing the use of DNA microarray studies to work toward understanding gene regulation in myopia[28]. In the meantime, clinician scientists at SERI have performed a series of four major randomised controlled trials exploring various modalities to modulate or retard myopia progression. A three-year randomised controlled trial (RCT) evaluating the use of rigid gas permeable contact lenses failed to provide evidence of retarding myopia in 428 Singaporean schoolchildren[29]. Another SERI RCT evaluating the use of progressive addition spectacles in 314 children similarly failed to show positive results (Chua WH, unpublished data, 2003).

The most promising results have been SERI's two most recent clinical trials using antimuscarinic eyedrops. The first RCT is ATOM, or the Atropine in the Treatment of Myopia Study, a randomised, placebo-controlled, double-masked, three-year clinical trial evaluating the unilateral use of 1% atropine eyedrops in 400 children[30]. ATOM was pivotal in providing conclusive, and highly promising results, showing an 80% reduction in myopia progression over a two-year span, proving that myopia progression can definitely be retarded pharmacologically. Importantly, safety data from the study (including sensitive electrophysiological measurements) confirmed that atropine appears to be well-tolerated and free from significant complications[31]. A second ATOM study evaluating the efficacy of lower concentrations of atropine is being planned. A second SERI RCT involving the use of 2% Pirenzepine ophthalmic gel, an analogue of atropine with less pupil dilating effects, has now also shown positive results in myopia retardation[32]. This FDA-regulated multicentre study involved 353 children from seven clinical sites in Singapore, Hong Kong and Thailand.

Finally, newer treatments may be on the horizon. Vision scientists have recently reported on the use of the visual neuroscience concept of "perceptual learning" to enhance visual acuity and contrast sensitivity in adult amblyopia or "lazy eye", a condition previously considered to be untreatable after the critical period of childhood. Polat et al showed in a RCT that perceptual learning could reverse amblyopia and improve visual acuity in adult unilateral amblyopes with the use of a

commercialised, non-invasive, patient-specific computerised treatment based on perceptual learning involving visual stimulation and facilitation of neural connections responsible for vision, with the best results occurring in myopic study subjects[33]. NeuroVision technology utilises visual stimuli to improve neuronal efficiency at the level of the visual cortex, inducing improvement of contrast sensitivity function due to a reduction of noise and increase in signal strength. Studies evaluating the use of this technology have begun at SERI, and initial results in a pilot study suggest that up to 80% of study subjects with low myopia of -1.5 D or less show spontaneous improvement in unaided visual acuity and contrast sensitivity after treatment[34]. Studies to evaluate the effect of NeuroVision treatment in children to possibly retard myopia progression are being planned. The future is near. SMJ

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NeuroVision technology utilises visual stimuli to improve neuronal efficiency at the level of the visual cortex, inducing improvement of contrast sensitivity function due to a reduction of noise and increase in signal strength.

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