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The use of rigid gas permeable contact lenses in children with myopic amblyopia: A case series

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ABSTRACT

Purpose: To explore the safety profile and overall visual improvement over the course of RGP contact lens wear on children with unilateral or bilateral amblyopia resulting from myopia.

Methods: This was a retrospective analysis case series study. Clinical records of 15 patients who were fitted with RGP contact lenses at the Shanghai Eye and EENT Hospital of Fudan University between the period of January 2009 to December 2014 were reviewed. The inclusion criteria for review included patients with myopia of −3.00DS or greater in one or both eyes and an initial best-corrected visual acuity (BCVA) of logMAR 0.4 or worse for 3 year olds, and logMAR 0.3 or worse for 4 years old and above. One or both myopic eyes were fitted with RGP lenses.

Results: 15 subjects and 22 amblyopic eyes were included. The mean baseline BCVA was logMAR 0.70 ± 0.38, which improved to a VA of 0.23 ± 0.28 at the time of review ($p < 0.05$). Baseline myopia also increased from −8.18 ± 2.93DS to −11.41 ± 3.76DS ($p < 0.05$). The final visual acuity at the time of this review was correlated with the initial refractive error ($r = -0.695$, $p < 0.05$) as well as the initial BCVA ($r = 0.854$, $p < 0.05$). There was also a strong correlation between initial refractive error and initial BCVA ($r = 0.-801$, $p < 0.05$)

Conclusion: RGP contact lens wear is a safe and effective refractive treatment option in young children with amblyopia due to myopia.

1. Introduction

Amblyopia is a reduction in the best-corrected visual acuity due to an abnormal visual experience during early childhood. This abnormal visual experience may be due to strabismus, uncorrected refractive error or visual deprivation (such as cataract), resulting in a structural and functional impairment of the visual cortex leading to poor vision, despite anatomically healthy eyes [1]. The prevalence of amblyopia in the population is reported to be 2.4% [2]. Amblyopia due to uncorrected refractive error, which can either be unilateral or bilateral, is a potentially reversible condition in children, if detected early. The most common cause of refractive error induced amblyopia is uncorrected hyperopia, with uncorrected myopia being a much less common cause. Several epidemiological studies have found that most children follow a similar pattern of ocular and refractive development from birth, with a relatively shorter axial length and more hyperopic refractive error (+1.00DS or above) that remain until the age of 5–6 years old [3]. Thus, the development of myopia in these early years is quite rare, with a prevalence of myopia (> −0.50DS) being only 1.00% in a population of 3–6 year old Chinese children, and of high myopia (at least −6.00D or above) being only 0.08% [4]. However, the prevalence of myopia can increase with age, with one study of a population of Chinese children demonstrating an increase in prevalence from 1.7% at an age of 4 years to 84.6% by the age of 17 years [3].

In most cases of refractive error induced amblyopia, spectacle correction is the first line of treatment. Several large-scale studies have demonstrated the effectiveness of optical correction alone in treating anisometropic and strabismic amblyopia, with complete resolution of amblyopia in the majority of children following treatment [5]. Spectacles are often employed due to the benefits of being easy to obtain and modify for younger patients. In certain cases of high anisometropia however, a large difference in spectacle powers may lead to a significant difference in retinal image size; which if large enough, may result in asthenopia. This difference can potentially disrupt binocular

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vision if the size difference exceeds 5% between the two eyes [6]. Thus when spectacles alone cannot be tolerated, contact lenses may be a viable and effective optical solution for these patients. However, concerns over potential complications from rigid gas permeable (RGP) contact lens wear, including corneal injury, infection or inflammation, do create some barriers to their use for both practitioners, as well as these young patients and their parents. In this study, 15 patients with unilateral or bilateral amblyopia resulting from myopia who presented to a tertiary Eye and ENT hospital for refractive correction involving the use of RGP contact lenses were reviewed. The safety profile and overall visual improvement over the course of RGP contact lens wear are reported.

2. Materials and methods

This study was approved by the institutional review board of The Eye and ENT Hospital of Fudan University. Written informed consent was obtained from all parents of patients prior to participating in the study. The study adhered to the guidelines and principles of the Declaration of Helsinki.

Clinical records of patients who were fitted with RGP contact lenses at the Shanghai Eye and EENT Hospital of Fudan University between the period of January 2009 to December 2014 were reviewed. The inclusion criteria for review included patients with myopia of −3.00DS or greater in one or both eyes and an initial best-corrected visual acuity (BCVA) logMAR of 0.4 or worse for 3 year olds, and logMAR 0.3 or worse for 4 years old and above. Only patients who were younger than 15 years old at their first presentation were included. Patients with known ocular pathology or strabismus were excluded.

Patients identified as meeting the above criteria were contacted by phone to schedule an appointment to visit the hospital for a comprehensive ocular examination. All patients underwent an examination including a cycloplegic refraction using 0.5% tropicamide, RGP fitting evaluation, posterior eye examination, and optical coherence tomography (OCT) to rule out organic causes of visual deterioration.

RGP fitting evaluations were conducted using fluorescein dye wetted with one drop of unpreserved saline and applied to the lower conjunctiva. RGP movement, centration and fluorescein patterns were observed under the slit lamp with a wratten filter attached. Patients were interviewed about their ocular history as well as any significant family ocular history. Patient clinical records were reviewed for incidences of corneal complications since commencing RGP wear. A clinical history was also taken from patients and parents questioning any complications of RGP wear.

Statistical analysis was performed using a statistics program (SPSS 19.0 IBM Corp, Armonk, NY, USA). All visual acuity data was converted to logMAR prior to analysis. A paired samples *t*-test was used to compare change in BCVA and myopia at baseline to present. An independent samples *t*-test was used to compare average vision improvement and myopic progression between those who underwent vision therapy or patching compared to those that did not. Non-parametric tests are utilised when the distribution is not normal. Pearson's correlation was used to evaluate the relationship between variables. $P < 0.05$ was considered statistically significant. For patients with unilateral amblyopia, only data from the amblyopic eye was used in the analysis.

3. Results

In total, 15 patients (7 boys and 8 girls), and 22 eyes (11 right eyes and 11 left eyes) met the criteria for inclusion in the analysis. Table 1 presents demographic data of all the patients included in the analysis. The age of the patients was rounded to the nearest 6 months. The average age of the patients was 8.73 ± 1.99 years (range 5 to 11.5 years old). 7 patients had bilateral amblyopia (subjects 1–7) and 8 patients had unilateral amblyopia (subjects 8–15). 4 patients with bilateral amblyopia had isometropic myopia (subjects 2–5) whilst the rest had anisometropic myopia (defined as an interocular difference in spherical equivalent refractive error of 1.00D or more).

The average initial age of all patients at the commencement of refractive treatment was 4.07 ± 1.55 years old. The total length of refractive treatment (including spectacles and RGP) was 4.67 ± 1.95 years. 12 patients were given spectacles as their initial form of refractive treatment before starting RGP wear. The average length of spectacle wear was 2.83 ± 1.93 years. 3 patients began RGP wear directly (subjects 13–15). The average length of RGP wear was 2.40 ± 1.85 years for all patients. 6 patients also underwent patching and/or vision therapy when they first started refractive treatment. At the time of review, no patients were still undergoing vision therapy; however 2 patients were still patching unilaterally (patients 12 and 14).

The mean baseline best corrected VA of the amblyopic eyes was logMAR 0.70 ± 0.38, which improved to logMAR 0.23 ± 0.29 at the time of review ($p < 0.05$). Myopia at initial presentation was −8.18 ± 2.93DS and at the time of review was on average −11.41 ± 3.76DS ($p < 0.05$). Overall, the patients VA had improved on average logMAR 0.47 ± 0.16 at the time of review, and 10 out of the 15 patients achieved resolution of their amblyopia, according to the definition of The Paediatric Eye Disease Investigator Group (BCVA of 6/9 or better) [7].

The final visual acuity at the time of this review was correlated with the initial spherical equivalent (SE) refractive error ($r = -0.695$, $p < 0.05$) as well as the initial BCVA ($r = 0.854$, $p < 0.05$) (Figs. 1 and 2). A strong correlation was also found between the initial SE refractive error and initial BCVA ($r = 0.-801$, $p < 0.05$) (Fig. 3). No association was found between the initial age of treatment and improvement in vision or final VA. There appears to be no statistically significant difference in terms of visual improvement or annual progression of myopia between patients who had undergone patching or vision therapy compared to those that did not ($p = 0.26$ and $p = 0.66$ respectively).

The safety profile of the use of RGP contact lenses was assessed both objectively and subjectively, and overall demonstrated a good safety profile of RGP contact lens wear in children. All patients' RGP fittings were deemed satisfactory, with no change of lenses required. No corneal staining was noted after removal of the lens in any case. All macula OCT results showed even retinal layers, with no scarring or abnormalities noted. Upon review of patient records, no adverse effects were noted in the patient clinical records. Upon questioning, parents also did not report any adverse effects requiring treatment or cessation of RGP wear. All patients reported satisfactory visual and ocular comfort with RGP wear.

4. Discussion

Amblyopia is the most common cause of vision loss in children. However, vision can be restored if the underlying cause of the amblyopia is detected and treated early. In this case series review of 15 children who were treated with optical correction for amblyopia due to unilateral or bilateral myopia, the author found an average improvement in logMAR acuity from 0.70 ± 0.38, to 0.23 ± 0.29 over an average treatment course of 4.67 ± 1.95 years, using spectacles followed by RGP contact lenses for most cases. We found no adverse effects associated with RGP wear, with parents and patients all considering RGP wear satisfactory in terms of vision and ocular comfort. Compliance with contact lens wear was good, and no evidence of adaptation problems to RGP wear were noted. Although some studies have demonstrated that adaptation to RGP contact lens wear may occasionally pose an issue for younger patients, particularly concerning handling issues related to insertion and removal [8] this was not the case in the cohort of patients reviewed in this study.

Optical correction alone may often be sufficient to treat most cases of refractive error induced amblyopia, as demonstrated by The