

Myopia control with dual-focus soft contact lenses during the first year of measures to contain the COVID-19 pandemic

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Abstract

Purpose: This study compared refractive and axial length (AL) changes in children wearing dual-focus soft contact lenses for myopia control (MiSight®) with myopic children wearing spectacles one year from the start of lockdown during the COVID-19 pandemic.

Methods: This retrospective, descriptive, parallel-group, observational study reviewed the charts of 11 children who began treatment for myopia control with dual-focus soft contact lenses for myopia control (MiSight®) in March 2020 and 11 matched spectacle-wearing controls. The mean increase in spherical equivalent refraction (SER) and AL from the beginning of the lockdown and up to 1 year later were compared. The parents of the children were asked about the average time spent on near work, contact lens wearing time both during and after the strict confinement and whether they had discontinued contact lens wear during lockdown.

Results: During this first year of preventive COVID-19 measures (March 2020–March 2021), for the contact lens group the average SER and AL increased -0.14 ± 0.09 D and 0.13 ± 0.05 mm, respectively. For the spectacle wearers, the corresponding increases were -0.54 ± 0.16 D and 0.25 ± 0.08 mm, respectively. A significant difference was found between the groups for both SER ($p < 0.001$) and AL ($p < 0.05$). The average time spent outdoors was restricted for both groups during lockdown and increased after. However, statistically significant changes in the time spent outdoors during and after lockdown were only found for the spectacle group ($p < 0.05$; t -test), whereas this change was not significant for the contact lens group ($p = 0.08$).

Conclusions: Over the observed time period, dual-focus soft contact lenses for myopia control were effective despite the decreased time spent outdoors during the COVID-19 pandemic.

KEYWORDS

COVID-19, dual-focus soft contact lenses, lockdown, MiSight, myopia control

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INTRODUCTION

The emergence of the coronavirus (COVID-19) in China at the end of 2019 and its rapid spread worldwide resulted in a major change in our way of life. Due to the initial lack of knowledge about the virus, as well as its rapid spread and virulence, which led to hospital overload, the governments of many countries were forced to take measures to limit its spread.^{1,2} In the case of Spain, the lockdown was decreed in March 2020, and lasted a total of 99 days. Specifically, for the first 40 days, one was not permitted to go outside except for essential activities, and thus children were not allowed to spend time outdoors. Thereafter, outdoor life was allowed for a limited amount of time per day, which was gradually extended. During this period, children's education continued online, which meant an increase in screen time per day. During the 2020–2021 school year, school children followed a synchronous hybrid learning modality (a combination of in-person and online methodologies). Thus, the children's routine was to attend online classes using digital devices, increasing screen time and reduced time spent outdoors. All of these factors could impact the effectiveness of dual-focus soft contact lenses for myopia control. Measures taken to avoid the spread of the virus, such as lockdown and synchronous hybrid learning, may have worsened the burden of myopia,³ and/or impaired the effectiveness of strategies to reduce its progression,^{1,4} as they have markedly changed the lifestyle of schoolchildren.^{5,6}

Therefore, this study compared refractive error and axial length (AL) changes in both children wearing dual-focus soft contact lenses for myopia control (MiSight®, CooperVision, coopervision.com) and spectacle-wearing myopic children over a 1 year period from the start of lockdown.

METHODS

This retrospective, descriptive, parallel-group, observational study complied with the tenets of the Declaration of Helsinki and received ethical approval from the Research Ethics Committee of the University of Murcia.

The charts of 11 children who began treatment with dual-focus soft contact lenses for myopia control (MiSight®) in March 2020 and 11 randomly selected matched controls of similar age and gender who wore spectacles during the same period of time were reviewed. Contact lens wearers were instructed to wear their dual-focus soft contact lenses for at least 8 h per day regardless of the lockdown regulations.

Cycloplegic spherical equivalent refraction (SER) was measured using an auto-refractometer (RM-8000B, Topcon, topcon.com), followed by subjective refraction. Cycloplegia was achieved with two drops of 1% tropicamide. AL was measured using ocular biometry (IOL Master 700; Carl Zeiss Meditec, zeiss.com) at the beginning

Key points

- The effectiveness of dual-focus soft contact lenses for myopia control does not appear to be affected by time spent outdoors.
- Compliance with lens wear is a key factor to maintain the effectiveness of dual-focus soft contact lenses in controlling myopia progression.
- Results suggest that during the lockdown, dual-focus soft contact lenses for myopia control were more effective in controlling axial length growth than the equivalent spectacle correction.

of treatment (March 2020) and 1 year later (March 2021). The mean increase in SER and AL over this time period was compared between the two groups. The parents of the subjects were asked about the average time the children spent performing near work, the average time their children wore their contact lenses both during and after the confinement and whether they had discontinued contact lens wear during the lockdown.

Data were analysed using the Statistical Package for Social Sciences (SPSS) software version 24 (IBM, ibm.com). Data were tested for normality and a paired *t*-test was performed to compare the data between the two study groups and within each group across time. The level of significance was set at $p < 0.05$.

RESULTS

Twenty-two children participated in the study, half of whom wore contact lenses for myopia control. At baseline, participants in the spectacle group were slightly older than those in the contact lens group (Table 1). Participants in the spectacle group also had a higher mean SER and AL at baseline than the contact lens group (Table 1). The average time spent outdoors was presumably higher after lockdown for both groups, but this difference was only significant for the spectacle group (Table 2). However, the time spent doing near work was similar both during and after the lockdown in the spectacle group but higher in the contact lens group after lockdown, although no statistically significant differences were found (Table 2).

The mean duration of dual-focus soft contact lens wear was similar both during and after lockdown (Table 2). In the contact lens group, the average SER and AL at the beginning of the treatment (March 2020) were -2.13D (95% C.I. $-1.58, -2.68$) and 24.26 mm (95% C.I. $23.92, 24.6$) for the right eye and -2.26D (95% C.I. $-1.82, -2.7$) and 24.25 mm (95% C.I. $23.97, 24.53$) for the left eye. The average SER and AL 1 year later (March 2021) were -2.30D (95% C.I. $-1.7, -2.9$) and 24.40 mm (95% C.I. $24.05, 24.75$) for the right eye and -2.38D (95% C.I. $-1.92, -2.84$) and 24.38 mm (95% C.I.

TABLE 1 Cycloplegic spherical equivalent refractive error (SER) and axial length (AL)

	Contact lens group					Spectacle group					
	March 2020		March 2021		Difference across time	March 2020		March 2021		Difference Across Time	
	Mean	95% CI	Mean	95% CI		Mean	95% CI	Mean	95% CI		
Age (years)	12	[10.7, 13.3]				13.4	[12.16, 14.56]				
SER (D)	−2.19	[−1.7, −2.68]	−2.34	[−1.82, −2.86]	$p < 0.05$	−2.63	[−1.59, −3.67]	−3.18	[−2.11, −4.25]	$p < 0.001$	
AL (mm)	24.25	[24.12, 24.56]	24.39	[24.07, 24.71]	$p < 0.05$	24.58	[23.87, 25.29]	24.84	[24.17, 25.51]	$p < 0.001$	
Contact lens group						Spectacle group				Difference between groups	
Mean		95% CI		Mean		95% CI					
Mean change											
SER (D)		0.15		[0.06, 0.24]		0.55		[0.39, 0.71]		$p < 0.001$	
AL (mm)		0.14		[0.09, 0.19]		0.26		[0.18, 0.34]		$p < 0.05$	

Note: Values in the table correspond to the mean values and the 95% confidence interval of the two eyes.

TABLE 2 Time spent outdoors, doing near work and contact lens wear per day

	Lockdown		After lockdown		Difference across time
	Hours	95% CI	Hours	95% CI	
Contact lens group					
Time spent outdoors	0.45	[0.05, 0.95]	2.86	[2.19, 3.53]	$p = 0.08$
Time in near work	6.77	[5.46, 8.08]	8.31	[7.38, 9.24]	$p = 0.07$
Time of contact lens wear	9.72	[8.57, 10.87]	9.9	[8.94, 10.86]	$p = 0.40$
Spectacle group					
Time spent outdoors	1.63	[0.36, 2.9]	3.45	[2.7, 4.2]	$p < 0.05$
Time in near work	6.5	[4.82, 8.18]	6.31	[5.2, 7.42]	$p = 0.5$

24.08, 24.68) for the left eye. The findings from both eyes were averaged (Table 1), and during this year of preventive COVID-19 measures (March 2020–March 2021) the average SER and AL increased by -0.15D (95% C.I. $-0.05, -0.23$) and 0.14mm (95% C.I. $0.08, 0.18$), respectively. This increase was statistically significant ($p < 0.05$ for both SER and AL -Table 1).

In the spectacle wearers, the average SER and AL at the beginning of the treatment (March 2020) were -2.57D (95% C.I. $-0.99, -3.63$) and 24.57mm (95% C.I. $23.89, 25.25$) for the right eye and -2.69D (95% C.I. $-1.65, -3.73$) and 24.60mm (95% C.I. $23.86, 25.34$) for the left eye. The average SER and AL one year later (March 2021) were -3.15D (95% C.I. $-2.07, -4.23$) and 24.83mm (95% C.I. $24.18, 25.48$) for the right eye and -3.20D (95% C.I. $-2.13, -4.27$) and 24.84mm (95% C.I. $24.15, 25.53$) for the left eye. The findings from both eyes were averaged (Table 1), and during this year of preventive COVID-19 measures (March 2020–March 2021), the average SER and AL increased by -0.55D (95% C.I. $-0.38, -0.70$) and 0.26mm (95% C.I. $0.17, 0.33$), respectively. This increase was statistically significant ($p < 0.05$ - Table 1). The increase in both

SER ($p < 0.001$) and AL ($p < 0.05$) was significantly higher in the spectacle group.

DISCUSSION

These results show that dual-focus soft contact lenses maintained their effectiveness for myopia control despite lockdown measures and hybrid learning. Compliance with contact lens wear is important in order to maintain its effectiveness in controlling myopia progression. The fact that the participants in this study continued to wear their contact lenses for more than 8 h every day may have been a key factor in maintaining their efficacy, regardless of the measures taken to control the COVID-19 pandemic. Interestingly, even during confinement, the number of hours of daily contact lens wear was maintained in this population, in contrast to the reduction in wearing time observed in the general population.²

Some investigations examining the effectiveness of these dual-focus soft contact lenses refer to changes in the subjective refraction in diopters, while others used AL to assess

the response. In the present study, we chose to use AL, as it is generally accepted that this is the main ocular component in the progression of myopia. Additionally, excessive AL growth is associated with future pathology. Prieto-Garrido et al.⁷ defined “responders” to dual-focus soft contact lens treatment as those with an AL increase of <0.11 mm per year. In the present study, the increase in AL during the 12-month period in the dual-focus soft contact lens group was 0.13 mm. Based on the criterion stated above, the lens efficacy achieved here was lower than expected, possibly due to the decreased time spent outdoors. However, in terms of reducing axial elongation, the present study showed 52% less AL growth after 1 year of dual-focus soft contact lens wear, which is consistent with other studies showing 50%⁸ and 62%⁹ efficacy after 1 year of wearing the same type of contact lenses. Additionally, these previous reports observed mean axial elongation of 0.12⁸ and 0.09 mm⁹; comparable to the growth of 0.13 mm found in the present study. The first key investigation that tested the efficacy of this dual-focus lens design¹⁰ showed a reduction in AL growth of 0.11 mm and efficacy in reducing eye elongation of 49%.¹⁰ Therefore, the efficacy found here is very similar to that of previous studies using the same myopia control method.

A recent report proposed that time spent outdoors was the main factor in controlling myopia progression in children using dual-focus soft contact lenses.⁷ The association between time spent outdoors and myopia onset is now well established,^{11,12} with the most plausible explanation being the increase in dopamine production following sunlight exposure.¹³ However, the role of outdoor light exposure and myopia progression remains controversial.¹¹ In contrast, Ma et al. proposed a stronger association between myopia progression and digital screen use, rather than the effect of time spent outdoors.¹⁴ The measures taken to prevent the spread of COVID-19 led not only to a reduction in time spent outdoors and therefore sunlight exposure but also an increase in the time spent viewing screens. The results of the present study are similar to others that have used this contact lens intervention (see above), so although AL growth after 1 year of treatment was slightly greater than the minimum estimated change necessary to reach clinical significance,^{11,15} the results still suggest that these variables, i.e., exposure to sunlight and/or screens, do not have a significant impact on the control of myopia progression with contact lenses.

However, it is important to note that the measures taken to contain the COVID-19 pandemic may have caused greater myopia onset and progression,^{3,14,16} as well as impacting the effectiveness of other treatments to control myopia progression such as atropine.¹⁴ Indeed, recent work has proposed that the increase in myopia observed during the COVID-19 pandemic could be influenced by accommodative spasms.³ Interestingly, in this study, greater effectiveness was found in controlling AL (52%) compared with the SER (27%), which further supports this hypothesis. Our results are similar to those showing that lockdown did

not lead to an increase in AL in children undergoing orthokeratology treatment.¹⁷

One of the main limitations of this study is that it was retrospective, and therefore bias could be induced in the selection of participants. However, to avoid this, we included all patients who started myopia control treatment in March 2020 in the experimental group and included an age-matched random sample of patients with similar follow-up dates in the control group. Although this study has limitations, since the sample is small and other factors should be considered, and the results should be analysed with caution pending further studies based on larger sample sizes, it appears that dual-focus soft contact lenses were still effective for myopia control despite the decreased time spent outdoors due to the measures initiated to contain the COVID-19 pandemic.

AUTHOR CONTRIBUTIONS

Emma Cabanes Marti: Data curation (equal); formal analysis (equal); investigation (equal); methodology (equal); writing – review and editing (equal). **Diego Garcia-Ayuso:** Conceptualization (equal); formal analysis (equal); investigation (equal); methodology (lead); project administration (equal); supervision (lead); writing – original draft (lead); writing – review and editing (lead).

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CONFLICT OF INTEREST

The authors report there are no competing interests to declare.

DATA AVAILABILITY STATEMENT

Data available within the article.

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