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REVIEW ARTICLE

Assessing the rebound phenomenon in different myopia control treatments: A systematic review

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Abstract

Purpose: To review the rebound effect after cessation of different myopia control treatments.

Methods: A systematic review that included full-length randomised controlled studies (RCTs), as well as post-hoc analyses of RCTs reporting new findings on myopia control treatments rebound effect in two databases, PubMed and Web of Science, was performed according to the PRISMA statement. The search period was between 15 June 2023 and 30 June 2023. The Cochrane risk of bias tool was used to analyse the quality of the selected studies.

Results: A total of 11 studies were included in this systematic review. Unifying the rebound effects of all myopia control treatments, the mean rebound effect for axial length (AL) and spherical equivalent refraction (SER) were 0.10 ± 0.07 mm [−0.02 to 0.22] and −0.27 ± 0.2 D [−0.71 to −0.03] after 10.2 ± 7.4 months of washout, respectively. In addition, spectacles with highly aspherical lenslets or defocus incorporated multiple segments technology, soft multifocal contact lenses and orthokeratology showed lower rebound effects compared with atropine and low-level light therapy, with a mean rebound effect for AL and SER of 0.04 ± 0.04 mm [0 to 0.08] and −0.13 ± 0.07 D [−0.05 to −0.2], respectively.

Conclusions: It appears that the different treatments for myopia control produce a rebound effect after their cessation. Specifically, optical treatments seem to produce less rebound effect than pharmacological or light therapies. However, more studies are required to confirm these results.

KEYWORDS
atropine, DIMS/HAL spectacles, dual-focus contact lens, extended depth of focus contact lens, low-level light therapy, orthokeratology, rebound effect

INTRODUCTION

In the next decade, myopia is expected to present a significant threat to ocular health worldwide.[1] This concern arises from its increasing prevalence,[2,3] as well as its close association with ocular conditions, such as cataracts, glaucoma, myopic maculopathy and retinal detachment.[4,5] Therefore, myopia represents a significant challenge for the scientific and medical community, and it is crucial to address this problem effectively to prevent possible adverse consequences on visual health.[6]

The onset and progression of myopia have been associated with several environmental factors, such as tasks requiring near-vision, decreased time spent outdoors and

educational level.[7–9] Hyperopic peripheral retinal defocus has also been reported as a risk factor for myopia progression.[10] Therefore, new optical designs that generate myopic peripheral retinal defocus have emerged to control myopia progression, such as spectacles with highly aspherical lenslets (HALs)[11,12] or defocus incorporated multiple segments (DIMS) technology,[13] orthokeratology (Ortho-K)[14] and soft multifocal contact lenses (CLs).[15,16] However, these designs may induce optical aberrations affecting visual quality.[17] Regarding pharmacological treatments, low concentration atropine is an effective and safe drug in slowing myopia progression.[18] In addition, it can be also considered as a viable option for combination therapy with any of the optical treatments to enhance the efficacy of myopia control.[19] Recently, new light therapy devices, such as low-level light therapy (LLLT) seem to achieve promising results for myopia control.[20] Therefore, the long-term efficacy, as well as the possible rebound effects of these treatments, are an important area of study.

Rebound effect is defined as the greater myopic progression that occurs after cessation of myopia control treatment, with the participant ultimately reaching the same level of myopia observed in a child of the same age and with similar environmental factors who did not receive any myopia control treatment.[21] Although several studies have evaluated the efficacy and safety of different myopia control treatments,[11–16,18,20] there is no systematic review analysing the changes in axial length (AL) and spherical equivalent refraction (SER) after the cessation of myopia control treatments.

Therefore, the purpose of this systematic review was to evaluate the rebound effect of different myopia control treatments. Through this review, a comprehensive overview of the current evidence on myopic rebound effect is provided, enabling evidence-based decision-making and guiding future research directions.

Key points

- A rebound effect can be observed after the discontinuation of different myopia control treatments.
- Optical treatments seem to produce less rebound effect than pharmacological or light therapies. However, the latter treatments seem to achieve better control of myopia progression.
- Being aware of the rebound effect of myopia control treatments could help healthcare professionals and patients plan for continued myopia treatment effectively and choose the most suitable treatment option.

METHODS

Data sources and search strategy

This systematic review was performed according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA).[22,23] We identified 1242 articles published before 29 September 2023 through the following databases: PubMed, Web of science and Scopus. The data search strategy with Boolean operators was as follows: (myopia control OR slowing myopia) AND (myopia progression OR rebound effect) AND (atropine OR dual focus contact lens OR MiSight contact lens OR extended depth of focus [EDOF] contact lens OR orthokeratology OR spectacles lenses OR defocus incorporated multiple segments spectacles OR DIMS spectacles OR highly aspherical lenslets OR HAL spectacles OR low-level light therapy OR LLLT OR red light). The references of the retrieved articles were reviewed to identify other related studies if they met the inclusion criteria.

Study selection

All 1242 articles identified through the search strategy were considered and analysed. Duplicate studies were removed by DistillerSR software (distillersr.com). The remaining studies underwent additional screening stages, which included title, abstract and full-text screening. Studies unrelated to the topic were excluded from the review during title and abstract screening. Full-text screening studies that did not include myopia control therapy rebound effect were also excluded. These studies were reviewed by two investigators (ABS and JMSG) who selected them according to the inclusion and exclusion criteria. The inclusion criteria were as follows: prospective randomised controlled trials (RCTs), as well as post-hoc analyses of RCTs reporting new findings on the myopia control therapy rebound effect. Exclusion criteria included non-English publications and unindexed journals. There were no restrictions placed on the country in which the study was performed, the follow-up period, the sample size or results of the studies.

Quality assessment and data extraction

Data from each study were collected and summarised independently in tables designed by two researchers (ABS and JMSG). The following information was obtained from each article: (1) author and date of publication (year), (2) study design, (3) mean follow-up of all patients in the whole procedure (expressed in months), (4) number of patients, (5) mean age of the patients (expressed in years), (6) patient sex (female/male), (7) number of eyes involved, (8) inclusion criteria of the studies, (9) study group intervention, (10) control group intervention, (11) washout period of myopia control therapy and (12) conflicts of interest.

Regarding the results of the studies, the following data were collected: (13) AL (expressed in millimetres, mm); (14) SER with cycloplegia (expressed in dioptres, D) and (15) the

authors' judgement expressed by commenting in favour or against the myopia control therapy. Data synthesis was performed according to the Cochrane guideline for synthesis without meta-analysis (SWiM).[24] Baseline and last visit values for all these variables were collected in the myopia control therapy group. Intragroup clinical outcomes were defined as 'Last visit (LV) − Baseline (B) differences'. Myopia control therapy rebound effects were defined as '(Intragroup difference cessation group$_{LV-B}$) − (Intragroup difference continuation group$_{LV-B}$)'. Mean ± standard deviations for each variable were calculated to report intragroup clinical outcomes and myopia control therapy rebound effect. Specifically, the mean AL and SER rebound effect was calculated through the rebound effect reported in each study.

The literature that remained after full-text screening was examined to assess the quality of the studies. To avoid the risk of bias, two authors created a synopsis based on the Cochrane risk of bias tool,[24] which includes the following items: (1) random sequence generation, (2) allocation concealment, (3) blinding of participants and personnel, (4) blinding of outcome assessment, (5) incomplete outcome data, (6) selective reporting and (7) other sources of bias. A third non-blinded assessor decided the quality of the studies when disagreements occurred between the two assessors.

To present a clear and comprehensive visualisation of the risk of bias across included studies, we used the Risk of Bias Visualisation (Robvis) tool. Robvis produces colour-coded, easy-to-interpret plots that represent the risk of bias assessments for individual studies as well as summary assessments across studies. Each domain assessed by the Cochrane risk of bias tool was represented in the Robvis plot, allowing for a quick but thorough understanding of the quality of the evidence included in this review.

RESULTS

Study characteristics

The study selection process of this systematic review is presented with a flow chart diagram (Figure 1). The design of the included studies was prospective RCTs published between 2013 and 2023. This systematic review included 1704 eyes

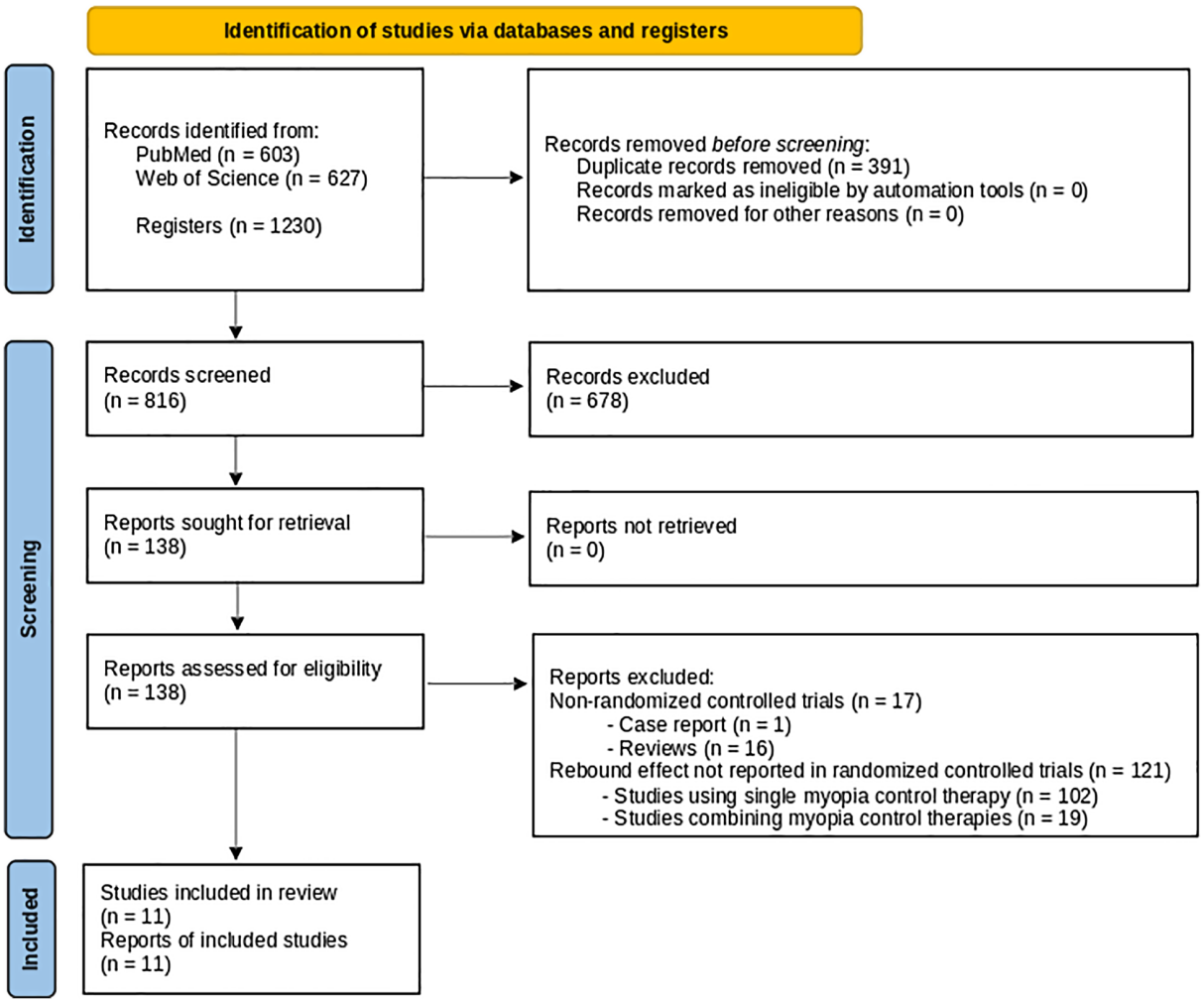

FIGURE 1 Flow chart study selection process according to the PRISMA statement.

from 1704 patients with a mean age of 10.5 ± 0.9 years. The sex distribution was 797 females (46.7%) and 907 males (53.2%). Patient follow-up ranged from 12[25,26] to 72 months,[27] with a mean follow-up of 26.1 ± 16.7 months. Regarding study group intervention, different myopia control therapies were used, such as atropine,[26,28–30] soft multifocal CL,[16,25] DIMS/HAL spectacles,[27,31] Ortho-K[32] and LLLT.[33,34] Concerning the control group intervention, placebo,[26,28–30] single-vision spectacles[27,31–35] and single-vision CL[25] were used. The washout period of myopia control therapies ranged from 1 month[36] to 30 months,[27] with a mean washout period of 10.2 ± 7.4 months. Six studies reported no conflicts of interest (CoI),[16,26,28,29,32,34] while five studies reported CoI by the authors.[25,27,30,31,33] More detailed study characteristics and myopia control therapies are presented in Table 1.

Outcomes

Regarding efficacy outcomes, 11 studies reported a rebound effect after cessation of different myopia control therapies.[25–35] From these 11 studies, 6 reported data for both subgroups, one that stopped the myopia control treatment (cessation group) and another that continued the myopia control treatment (continuation group).[16,25,27,29,31,33] For the other five studies, the values of the continuation group have been estimated as the mean values through the treatment period, adjusted to the follow-up period of the cessation group (Last visit − baseline visit) × (cessation period/treatment period).[26,28,30,32,34]

Intragroup clinical outcomes and rebound effect are presented in Table 2. AL and SER values were found to be higher in the cessation groups compared with the groups that continued myopia control treatment. In a comprehensive assessment encompassing all types of myopia control therapies, mean continuation subgroup AL was 0.13 ± 0.1 mm [−0.08 to 0.30]. However, the mean cessation subgroup AL was 0.23 ± 0.11 mm [0 to 0.40]. These results suggest a mean rebound effect for the AL variable of 0.10 ± 0.07 mm [−0.02 to 0.22]. In refraction terms, mean continuation subgroup SER was −0.22 ± 0.19 D [−0.48 to 0.30]. However, the mean cessation subgroup was −0.49 ± 0.2 D [−0.91 to −0.2]. This implies a mean rebound effect for the SER variable of −0.27 ± 0.2 D [−0.71 to −0.03]. To better understand the average rebound effect based on the myopia control treatment, the data were segregated into five different techniques as shown in Table 3. Spectacles with HAL or DIMS technology, soft multifocal CLs and Ortho-K showed lower rebound effects compared to atropine and LLLT, with a mean rebound effect in terms of AL and SER of 0.04 ± 0.04 mm [0 to 0.08] and −0.13 ± 0.07 D [−0.05 to −0.2], respectively.

Risk of bias

The risk of bias summary of the included studies is presented in Figure 2. Risk of bias assessment was classified into three evidence level groups: (1) studies with a low risk of bias (Chia et al.,[28] Wei et al.,[30] Chen et al.,[34] Sankaridurg et al.,[31] Weng et al.,[25] Yam et al.,[29] Lam et al.[27] and Medghalchi et al.[26]); (2) studies with an unclear risk of bias (Xiong et al.[33]) and (3) studies with a high risk of bias (Ruiz-Pomeda et al.[16] and Zhu et al.[32]). The overall risk of bias summary of the domains used in each study is presented in Figure 3. The items used to assess the risk of bias showed an overall low risk of bias (75%). Therefore, no study was excluded due to risk of bias. The Robvis tool (bristol.ac.uk/population-health-sciences/projects/robis/robis-tool/) was used to create risk of bias assessment figures.[37]

DISCUSSION

Several treatments are currently used to control myopia progression.[38] Although the selection of myopia control treatment is an individualised process that considers a variety of environmental and genetic factors,[7–9] none of these treatments have been able to stop myopia progression completely.[39] This lack of efficacy may be due to a natural slowing of myopia progression with increasing age, as well as the fact that approximately 80% of myopes do not progress to high myopia.[9] In addition, a high percentage rebound effect, that varied across studies, was observed when these treatments were discontinued.[33,34] Therefore, this systematic review aimed to report the changes in AL and SER after cessation of the different myopia control treatments.

Spectacles

Undercorrection of myopia was inaccurately used to control myopia progression.[40] These treatments were thought to reduce the accommodative lag, which has been traditionally associated with myopia and its progression.[41] As expected, they did not achieve satisfactory results.[41,42] Currently, new spectacles designs incorporating HAL or DIMS technology in the mid-peripherical portion of the spectacles seem to be effective in slowing myopia progression.[11–13]

However, rebound effects were seen after discontinuation of the spectacle lenses. Sankaridurg et al.[31] measured the rebound effect 6 months after treatment with HAL spectacles in children with a mean age of 1.1 ± 1.6 years. They reported an important rebound effect, noting that the increase in AL was three times higher in the group that stopped the treatment. On the other hand, Lam et al.[27] reported that after cessation of DIMS spectacle wear, myopia continued to progress at the same rate as when they were worn, with a 24% rapid increase in AL in the group that stopped the treatment. In this investigation, the study was longer, measuring the rebound effect for 2.5 years, after 3.5 years of treatment. Therefore, children who ceased treatment were,

TABLE 1 Summary of included studies.

Author (Year)	Design	F/U[a]	Patients (TG/CG)	Age[b] (TG/CG)	Sex (F/M)	Eyes	Inclusion criteria (SER, D)	Intervention	Control	Washout period[a]	CoI
Chia et al. (2013)[28]	DM MN	24	347/NR	NR (11.7 ± 1.5/NR)	170/177	347	≥−2.00	Atropine (0.01%, 0.1% and 0.5%)	Placebo	12	No
Ruiz-Pomeda et al. (2021)[16]	UM MN	36	31/24	12.3 ± 1.6 (13 ± 1.2/11.9 ± 1.3)	NR	55	−0.75 to −4.00	Soft multifocal CL (Dual-focus)	Single vision spectacles	12	No
Wei et al. (2022)[30]	DM MN	24	65/68	9.6 ± 1.6 (9.9 ± 1.6/9.2 ± 1.6)	65/68	133	−1.00 to −6.00	Atropine (0.01%)	Placebo	12	Yes
Chen et al. (2022)[34]	SM MN	15	46/40	8.9 ± 1.6 (9 ± 1.9/8.9 ± 1.2)	34/52	86	−0.75 to −6.00	Low-level light therapy (635 nm)	Single vision spectacles	3	No
Sankaridurg et al. (2022)[31]	DM MN	19	54/65	11.1 ± 1.6 (11.2 ± 1.6/10.9 ± 1.7)	54/65	119	−0.75 to −4.75	HAL spectacles	Single vision spectacles	6	Yes
Weng et al. (2022)[25]	SM MN	12	65/30	10.8 ± 1.5 (10.8 ± 1.6/10.9 ± 1.5)	48/47	95	−0.75 to −3.50	Soft multifocal CL (Dual-focus and EDOF)	Single vision CL	6	Yes
Xiong et al. (2022)[33]	SM MT	24	63/51	10.6 ± 2.3 (10.4 ± 1.5/10.8 ± 3)	61/53	114	−1.00 to −5.00	Low-level light therapy (650 nm)	Single vision spectacles	12	Yes
Yam et al. (2022)[29]	DM MT	36	254/72	10.9 ± 1.8 (10.7 ± 1.7/11.1 ± 1.9)	145/181	326	≥−1.00	Atropine (0.01%, 0.025% and 0.05%)	Placebo	12	No
Lam et al. (2023)[27]	DM MT	72	50/40	10.1 ± 1.5 (9.8 ± 1.5/10.4 ± 1.6)	47/43	90	−1.00 to −5.00	DIMS spectacles	Single vision spectacles	30	Yes
Medghalchi et al. (2023)[26]	DM MN	12	40/20	11.1 ± 3.5 (10.6 ± 3.5/12 ± 3.6)	32/35	60	−2.00 to−6.00	Atropine (0.01% and 0.1%)	Placebo	6	No
Zhu et al. (2023)[32]	SM MN	13	142/137	9.2 ± 1.5 (9.2 ± 1.3/9.2 ± 1.7)	141/138	279	−1.00 to −5.00	Ortho-K	Single vision spectacles	1	No

Abbreviations: CG, control group; CL, contact lens; CoI, conflicts of interest; D, dioptres; DIMS; defocus incorporated multiple segments; DM, double-masked; EDOF, extended depth of focus; F, female; F/U, follow-up; HAL, highly aspheric lenslets; M, male; MN, monocentric; MT, multicentre; NR, not reported; SER, spherical equivalent refraction; SM, single-masked; TG, treatment group; UM, unmasked.

[a]Expressed as months.

[b]Expressed as mean ± standard deviation, years.

TABLE 2 Intragroup difference outcomes and rebound effect.

		Myopia control treatment						
		Continuation		Cessation		Rebound effect[c]		
Author (Year)		AL, mm	SER, D	AL, mm	SER, D	AL, mm	SER, D	F/A
Chia et al. (2013)[28]	Intragroup difference[a]	0.19	−0.23	0.24	−0.59	0.05	−0.36	F
Ruiz-Pomeda et al. (2021)[16]	Intragroup difference[b]	0.16	−0.37	0.22	−0.46	0.06	−0.09	F
Wei et al. (2022)[30]	Intragroup difference[a]	0.30	−0.48	0.39	−0.78	0.09	−0.3	F
Chen et al. (2022)[34]	Intragroup difference[a]	0.003	0.013	0.16	−0.2	0.157	−0.213	F
Sankaridurg et al. (2022)[31]	Intragroup difference[b]	0.06	−0.2	0.17	−0.33	0.11	−0.13	F
Weng et al. (2022)[25]	Intragroup difference[b] (EDOF CL)	0.06	−0.26	0.15	−0.3	0.09	−0.04	F
	Intragroup difference[b] (dual-focus CL)	0.08	−0.23	0.14	−0.26	0.06	−0.03	F
Xiong et al. (2022)[33]	Intragroup difference[b]	0.12	−0.2	0.42	−0.91	0.3	−0.71	F
Yam et al. (2022)[29]	Intragroup difference[b] (atropine 0.05%)	0.17	−0.28	0.33	−0.68	0.16	−0.4	F
	Intragroup difference[b] (atropine 0.025%)	0.20	−0.35	0.29	−0.57	0.09	−0.22	F
	Intragroup difference[b] (atropine 0.01%)	0.24	−0.38	0.29	−0.56	0.05	−0.18	F
Lam et al. (2023)[27]	Intragroup difference[b]	0.25	−0.30	0.31	−0.48	0.06	−0.18	F
Medghalchi et al. (2023)[26]	Intragroup difference[a]	−0.08	0.3	0.14	−0.33	0.22	−0.63	F
Zhu et al. (2023)[32]	Intragroup difference[a]	0.018	NR	0	NR	−0.018	NR	F

Abbreviations: A, against; AL, axial length; CL, contact lens; D, dioptres; EDOF, extended depth of focus; F, in favour; NR, not reported; SER, spherical equivalent refraction with cycloplegic.

[a]Estimation has been done with the treatment group as (Last visit – baseline visit) × (cessation period/treatment period), the authors did not report values for a group that continued the study.

[b]Defined as Last visit – Baseline.

[c]Defined as (intragroup difference cessation group$_{\text{Last visit – Baseline}}$) – (intragroup Difference continuation group$_{\text{Last visit – Baseline}}$).

TABLE 3 Mean rebound effect of different myopia control treatments.

Myopia control treatment	Rebound effect[a]		Washout period (months)
	AL, mm	SER, D	
Low-level light therapy ($n = 109$)	0.23 ± 0.07	−0.46 ± 0.25	7.5 ± 4.5
Atropine ($n = 706$)	0.11 ± 0.06	−0.35 ± 0.15	10.5 ± 2.6
DIMS/HAL spectacles ($n = 104$)	0.08 ± 0.03	−0.2 ± 0.03	18 ± 12
Dual-focus CL ($n = 96$)	0.07 ± 0.01	−0.05 ± 0.03	9 ± 3
Ortho-K[b] ($n = 142$)	−0.018	NR	1

Abbreviations: AL, axial length; CL, contact lens; D, dioptres, DIMS, defocus incorporated multiple segments; HAL, highly aspherical lenslets; NR, not reported; Ortho-K, orthokeratology; SER, spherical equivalent refraction with cycloplegic.

[a]Defined as (Intragroup difference cessation group$_{\text{Last visit – Baseline}}$) – (Intragroup difference continuation group$_{\text{Last visit – Baseline}}$).

[b]The rebound effect after Ortho-K cessation was evaluated by one study. Therefore, mean ± standard deviation could not be calculated.

on average, 14 years of age at the beginning of the follow-up period, finishing the study with a mean age of 16 years. The extension of treatment and the different ages of the participants clearly influence these variations in the results of the two studies.

This result seems to indicate that the centring of these spectacle designs plays a crucial role in controlling myopia progression.[43] In addition, it is important to perform a thorough evaluation of candidates for this treatment to ensure that they will wear the spectacles for a significant period of the day.[44]

Soft multifocal contact lenses

Centre-distance multifocal CLs have been studied extensively for myopia control.[40] Several studies have reported that high add power multifocal CLs achieve greater slowing of myopia progression.[45–47] However, these participants presented with poorer visual acuity and contrast sensitivity.[48] Therefore, new CL designs, such as the dual-focus and EDOF CLs, have been developed for myopia control, obtaining promising results.[15,16] Regarding the possible rebound effect, Ruiz-Pomeda et al.[16] reported a low rebound effect after cessation of dual-focus CL wear during 12 months of follow-up. Higher rebound values were reported by Weng et al.[25] with dual-focus and EDOF 6 months after discontinuation. Again, these rebound higher values, as seen with myopia control spectacles, could be due to differences in ages between the studies, with mean ages at the beginning of the follow-up

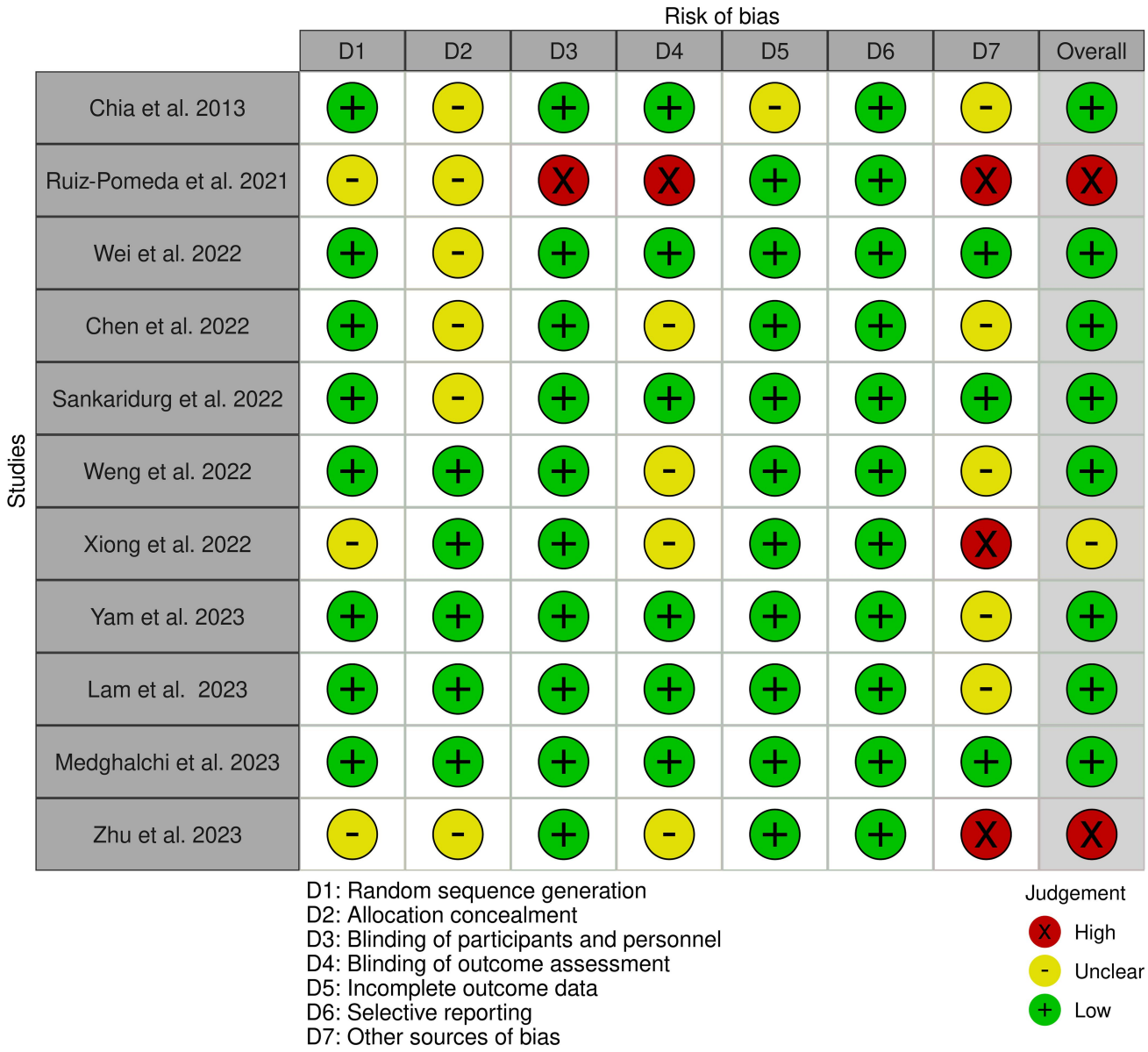

FIGURE 2 Risk of bias summary of the included studies[16,25–34] with traffic light plot. The colour of the traffic light represents the author's risk of bias judgement in each domain (D) used to assess the quality of the studies.

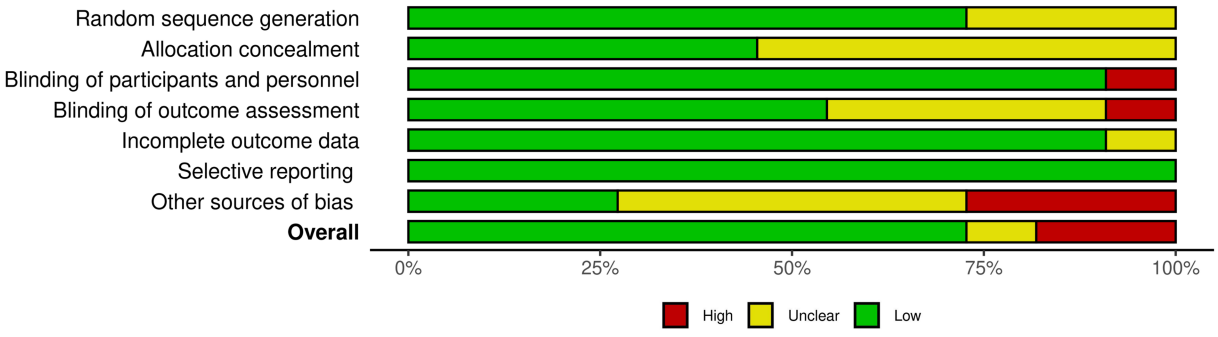

FIGURE 3 Overall risk of bias summary of the domains with a bar plot. Bar plots represent the overall author's risk of bias judgement in each domain presented as percentages.

of 13 and 11 years in Ruiz-Pomeda et al. and Weng et al., respectively. An additional factor to consider was the duration of treatment and follow-up, being 2 years of treatment and 1 year of follow-up in Ruiz-Pomeda et al., versus 6 months of treatment and 6 months of follow-up in Weng et al.

Nevertheless, the findings suggest that these CL designs may be effective in controlling myopia progression without experiencing a significant rebound effect. Further research is required to confirm these results.

Orthokeratology

In Ortho-K patients, the assessment of refractive changes is more complicated due to the corneal moulding induced by the rigid gas permeable CL. Therefore, the control of myopia progression is usually assessed through AL changes.[49] Zhu et al.[36] reported no significant AL changes in Ortho-K patients after 12 months of follow-up. In addition, no rebound effect was observed in this study, which may be explained because Ortho-K was only discontinued for 1 month. Therefore, it would be interesting to analyse the rebound effect by discontinuing treatment for a duration equal to or longer than the treatment period. However, several studies have reported an increase in AL after the cessation of Ortho-K. In addition, Swarbrick et al.,[50] Li et al.[51] and Wang et al.[52] concluded that AL was only relatively reliable in Ortho-K patients after the washout period. Therefore, taking as a cut off AL findings measured without a washout period to assess changes after ortho-K cessation may overestimate efficacy, especially in studies that included a control group.

Atropine

The use of different concentrations of atropine to control myopia progression has been widely studied.[18] Several investigations have demonstrated the efficacy of 1% atropine in slowing myopia progression.[53–55] However, adverse effects, such as mydriasis and a high rebound effect have limited the clinical use of this dosage.[56] Consequently, there has been a shift towards using atropine at much lower concentrations. Management of myopia with 0.01% and 0.05% atropine seems to be safe and effective for myopia control, producing a lower rebound effect.[26,28,29,30] Chia et al.[28] reported that 12 months after atropine cessation, the rebound effect was lower in participants who had received 0.01% atropine, compared with 0.5% and 0.1% concentrations. Similar results were reported by Wei et al.,[30] Yam et al.[29] and Medghalchi et al.,[26] with no significant rebound effect 10 ± 2.8 months after cessation of 0.01% atropine. In addition, Yam et al.[29] showed that younger children were more likely to exhibit a greater rebound effect than older children, which may be explained by the slower physiological myopia progression of the older children. However, it is also important to mention that growth hormone and oestrogen levels regulate muscarinic receptor activity,[57–59] which may influence treatment efficacy and the rebound effect. Overall, these results appear to indicate that 0.01% atropine has the lowest rebound effect and achieves significant control of myopia progression, but further studies comparing the rebound effects of 0.01%, 0.025% and 0.05% atropine are needed.

Low-level light therapy

Red light therapy is a new approach to control myopia progression in patients with moderate myopia.[20] Although the mechanism of action is not fully understood, this device emits a red light (650 nm) that seems to improve scleral hypoxia and thus prevent myopia progression.[20,60] RCTs evaluating myopia control with this treatment are limited. Chen et al.[34] and Xiong et al.[33] reported the highest rebound effect after LLLT cessation compared with the other myopia control treatments included in this systematic review. This rebound effect may be explained by the greater control of myopia progression reported in these studies. Therefore, further investigations are needed to elucidate the mechanism of action of LLLT, as well as the minimum potency of this therapy that achieves the best control of myopia progression with the least possible rebound effect.

Strengths and limitations

The main strength of this systematic review is that all included studies were RCTs with an overall low risk of bias. However, this study has several limitations. First, the heterogeneity of the interventions in both groups, which complicated comparisons between the investigations. In addition, the washout period differed across studies; thus, the methodologies were not always similar. For these reasons, a meta-analysis was not performed. Second, evaluation of the rebound effect was only performed at the end of the washout period, which may have influenced the results. Therefore, larger, well-designed, strictly blinded, multicentre RCTs with increased evaluations during the washout period are needed to determine the rebound effect of different treatments more accurately. Third, since this systematic review includes studies some 10 years apart, it is important to emphasise that the study designs will have changed over the years which could affect the outcome of our analysis. While this review offers a general understanding of the rebound effect with different myopia control treatments, it lacks any consideration as to how demographic and clinical factors such as race, baseline refractive error and parental myopia may influence treatment outcomes. Future research should aim to fill this gap by investigating the interactions between these variables and the effectiveness of different treatments, thus allowing for more personalised therapeutic strategies.

In conclusion, this study has shown that the different treatments methodologies for myopia control produce a rebound effect. In particular, spectacles with DIMS or HALs, double-focus or EDOF CLs and Ortho-K seem to produce a lower rebound effect than atropine and LLLT. However, these latter treatments seem to achieve better control of myopia progression. Therefore, further studies are needed to confirm these results.

AUTHOR CONTRIBUTIONS

Miguel Ángel Sánchez-Tena: Writing – review and editing (equal). **Antonio Ballesteros-Sánchez:** Conceptualization (equal); data curation (equal); formal analysis (lead); methodology (lead); software (lead); visualization (lead); writing – original draft (lead). **Clara Martinez-Perez:** Writing – review and editing (equal). **Cristina Alvarez-Peregrina:** Writing – review and editing (equal). **Concepción De-Hita-Cantalejo:** Writing – review and editing (equal). **María Carmen Sánchez-González:** Writing – review and editing (equal). **José-María Sánchez-González:** Conceptualization (lead); data curation (equal); formal analysis (equal); methodology (equal); visualization (equal); writing – original draft (equal).

CONFLICT OF INTEREST STATEMENT

The authors have no financial/non-financial competing interest.

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