# Supplementary content

**Title**: Defocus Incorporated Multiple Segments (DIMS) spectacle lenses slow myopia progression: a 2-year randomized clinical trial

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**Supplementary Methods**
**Other measurements at each follow-up**

Distance and near visual acuity (VA), amplitude of accommodation, lag of accommodation and horizontal phoria were performed with fully correction for distance at each 6-month follow up visit. Distance and near Log MAR VA were assessed using Logarithmic 2000 series ETDRS Charts with illuminator cabinet (Precision Vision Inc.) and Mixed Contrast European-Wide Near Vision Card (at 40cm) (Precision Vision Inc.) respectively. Near horizontal phoria was measured by using the Howell near phoria card. The magnitude and direction (+ve for eso, -ve for exo) were recorded to the nearest 0.5Δ. Accommodation responses were measured using an open-field autorefractor (Shin-Nippon NVision-K5001) while subjects were viewing a letter target at 33cm with print size of 20/30. Lag of accommodation was the difference between the measured accommodative response and the actual accommodative demand (3D).

**Visual performance with the experimental spectacles**
Visual performance was also assessed for both groups of subjects while they were wearing their spectacles. Measurement of distance and near VA, accommodation and binocular vision tests (stereopsis and phoria tests) were carried out for the subjects when they collected their spectacles. Distance and near Log MAR VA were assessed using Logarithmic 2000 series ETDRS Charts with illuminator cabinet (Precision Vision Inc.) and Mixed Contrast European-Wide Near Vision Card (at 40cm) (Precision Vision Inc.) respectively. Near horizontal phoria was measured by using the Howell near phoria card. Monocular and binocular amplitude of accommodation (D) was measured with RAF ruler. Accommodative responses were measured using an open-field autorefractor (Shin-Nippon NVision-K5001) while subjects were viewing a letter target at 33cm with print size of 20/30. Lag of accommodation was the difference between the measured accommodative response and the actual accommodative demand (3D). Stereoacuity (second of arc) was measured with Randot Stereotest at 40 cm with Polaroid goggles.
A questionnaire (appendix in the clinical protocol) about visual performance, comfort and frequency of symptoms with lens wear was also administered to subjects. They were interviewed by the unmasked investigators during the follow-up visits. The subjective rating on visual performance included vision quality with distance, intermediate and near viewing, and stability of perceived vision at distance and at near, etc. The grading score ranged from 1 (the poorest) to 10 (excellent). Scales for rating how often the symptoms occur with the lens wear range from 1 -10 (never to always). Data of visual performance between the two groups were compared by unpaired t-tests.



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**Supplementary Results**

**eTable 1.** The number of the drop-outs at different stages of the study

| After the visit of | DIMS | SV | Total |
|---|---|---|---|
| Baseline data collection | 9 | 5 | 14 |
| 6-month follow up | 3 | 2 | 5 |
| 12-month follow up | 0 | 0 | 0 |
| 18-month follow up | 2 | 2 | 4 |
| Total no. of drop-outs | 14 | 9 | 23 |

**eTable 2.** Reasons of drop-outs

| Main reasons | DIMS | SV | Total |
|---|---|---|---|
| Long time to wait for delivery of lenses | 5 | 0 | 5 |
| Refuse to undergo cycloplegia | 2 | 2 | 4 |
| Try other myopic control methods | 5 | 4 | 9 |
| Not willing or unable to attend follow-up | 2 | 3 | 5 |
| Total | 14 | 9 | 23 |



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**eTable 3.** The linear model analysis of factors and covariates and effect on slowing myopia progression

| **Factors** | **p-value** |
|---|---|
| Group | 0.000* |
| Time (visits) | 0.006* |
| Interaction of group and time | 0.408 |
| **Covariates** | **p-value** |
| Gender | 0.054 |
| Age | 0.004* |
| Baseline refraction (in SER) | 0.839 |
| Near phoria | 0.267 |
| Lag of accommodation | 0.193 |
| Parental myopia | 0.346 |
| Time spent on near works (hours per day) | 0.541 |
| Time spent at outdoors (hours per week) | 0.400 |

*The covariates showed significant effect



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**eTable 4.** Adjusted mean changes (standard error) in the cycloplegic spherical equivalent refraction and axial length for each experimental group

| | **DIMS (n=93)** | **SV (n=90)** | **Mean difference** |
|---|---|---|---|
| SER changes in dioptres, mean (SE) | | | |
| 6-month | -0.15 ± 0.05 | -0.32 ±0.04 | -0.17±0.04* |
| 12-month | -0.08 ± 0.06 | -0.18 ± 0.06 | -0.10 ±0.07* |
| 18-month | -0.10± 0.05 | -0.17 ± 0.05 | -0.07 ±0.07* |
| 24-month | -0.08± 0.06 | -0.18 ± 0.06 | -0.09 ±0.07* |
| Total | -0.41 ± 0.06 | -0.85 ± 0.08 | -0.44 ± 0.09* |
| Changes in AL (mm), mean (SE) | | | |
| 6-month | 0.05 ± 0.01 | 0.21± 0.02 | 0.16 ±0.04* |
| 12-month | 0.06 ± 0.02 | 0.12 ± 0.02 | 0.06 ±0.03* |
| 18-month | 0.04 ± 0.01 | 0.11± 0.02 | 0.07 ± 0.03* |
| 24-month | 0.06 ± 0.02 | 0.11 ± 0.02 | 0.05 ± 0.04* |
| Total | 0.21 ± 0.02 | 0.55 ± 0.02 | 0.34 ±0.04* |

M= months, D = dioptres, Δ = prism dioptres, DIMS lens= Defocus Incorporated Multiple Segments spectacle lens; SV = single vision spectacle lens.

*Statistically significant difference as compared to the SV group



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**eTable 5.** Other visual measurements with spectacle lens wear

| **Mean (SD)** | **DIMS** | **SV** | **Unpaired t-test, p-value** |
|---|---|---|---|
| Distance VA, Log MAR | -0.02 ± 0.07 | -0.01 ±0.05 | 0.1388 |
| Near VA, Log MAR | -0.02 ± 0.02 | -0.02 ± (0.04) | 0.2938 |
| Monocular AA for right eye, D | 13.7 ± 2.08 | 14.1 ± (2.12) | 0.266 |
| Binocular AA, D | 14.8 ± 2.08 | 15.3 ± (2.44) | 0.1243 |
| Lag of accommodation with 3D stimulus, D | 1.10 ± 0.40 | 1.16 ± (0.55) | 0.4341 |
| Stereopsis, second of arc | 25.8 ± 4.24 | 29.0 ± (6.10) | *0.004 |

D = dioptres, Δ = prism dioptres, DIMS lens= Defocus Incorporated Multiple Segments spectacle lens; SV = single vision spectacle lens



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**eTable 6.** A Summary of clinical studies of myopia control using optical treatment

| Authors (years) | Period (months) | Design | Age (years old), ethnicity | Rx (D) | Interventions and sample size (n) | Treatment effect in retarding myopia progression | |
|---|---|---|---|---|---|---|---|
| | | | | | | Study period in D (%) | Per year in D |
| Present study | 24 | Randomized, double masked | 8-13, Chinese | -1 to -5 | SV, n =81<br>DIMS, n=79 | 0.55 (60%) | 0.28 |
| Edward et al. (2002)[25] | 24 | Randomized, double masked | 7-10.5, Chinese | -1.25 to -4.5 | SVL, n = 132<br>PAL (1.5D Add), n = 121 | 0.14 (11%) | 0.07 |
| Gwiazda et al. (2003)[27] | 36 | Randomized, masked | 6-11, diverse ethnicity | -1.25 to -4.5 | SVL, n = 233;<br>PAL (2D Add), n= 229 | 0.20 (14%) | 0.07 |
| Hasbe et al. (2008)[28] | 18 | Randomized, masked, cross-over | 6-12, Japanese | -1.25 to -6. | SVL, n=44;<br>PAL (1.5D Add), n= 42 | 1st period: 0.31 (18%)<br>2nd period: 0.02 (2%) | 1st period: 0.2<br>2ndperiod: 0.01 |
| Yang et al. (2009)[29] | 24 | Randomized, masked | 7-13, Chinese | -0.5 to -3 | SVL, n=75<br>PAL (1.5D Add), n=74 | 0.26 (17%) | 0.13 |
| COMET2 and PEDIG (2011)[30] | 36 | Randomized, masked, multi-centre | 8 to12, diverse ethnicity | -0.75 to -2.5 | SV, n =58<br>PAL (2D Add), n= 52 | 0.28 (24%) | 0.09 |
| Berntsen et al. (2012)[30] | 12 | Randomized, masked, worn SV in 2nd year | 6 to11, diverse ethnicity | -0.75 to 4.50 | SV, n =42<br>PAL (2D Add), n= 41 | 0.18 (35%) | 0.18 |
| Cheng et al. (2014)[34] | 36 | Randomized, masked | 8-13, Chinese-Canadian | -1 to -5.5 | SVL, n=41;<br>BF (1.5D Add), n=48;<br>PBF (1.5D Add, 3ΔBI), n=46 | BF: 0.81 (39%)<br>PBF: 1.05 (51%) | BF: 0.27<br>PBF: 0.35 |
| Sankaridurg et al.(2010)[32] | 12 | Randomized | 6-16, Chinese | -0.75 to -3.50 | 4 groups, type I, III lenses, control, n = 50 each group<br>Type II, n =60 | Type III lens (30% in subgroup of children with myopic parents) | - |
| Anstice and Phillips (2011)[22] | 10 | Randomized, paired-eye control, cross-over | 11-14, diverse ethnicity | -1.25 to -4.5 | SVCL, n=40<br>DF (2D MD), n=40 | 1st period: 0.25 (37%)<br>2nd period: 0.2 (54%) | 1st period: 0.3<br>2nd period: 0.24 |
| Lam et al. (2013)[23] | 24 | Randomized, masked | 8-13, Chinese | -1 to -5 | SVCL, n=65<br>DISC, n=63 | 0.21 (20%)<br>0.54 (58% in children with WT>7 hours) | 0.26 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Sankaridurg et al. (2011)[33] | 12 | Randomized | 7-14, Chinese | -0.75 to -3.5 | SVL, n=40<br>novel CL, n= 45 | 0.29 (34%) | 0.29 |
| Aller et al. (2016)[24] | 12 | Randomized, masked | 8-18 | -0.50 to -6.0 | SVCL, n=-40<br>BFSCL, n=39 | 0.57 (72% in children with eso fixation disparities) | 0.57 |
| Chamberlain et al. (2018)[35] | 36 | randomized, double-masked, multi-centre | 8-12 | -0.75 to -4.00 | DF (Add +2D), n = 70<br>SVCL, n = 74 | 0.73 (59%) | 0.24 |

COMET2 and PEDIG = Correction of Myopia Evaluation Trial 2 Study Group and the Paediatric Eye Disease Investigator Group, SVCL = single vision contact lens, SVL = single vision spectacle lens, PAL = progressive addition lens, BF = bifocal spectacle lens, PBF = prismatic bifocal lens, DF = dual focus contact lens, MD = myopic defocus, WT = wearing time.



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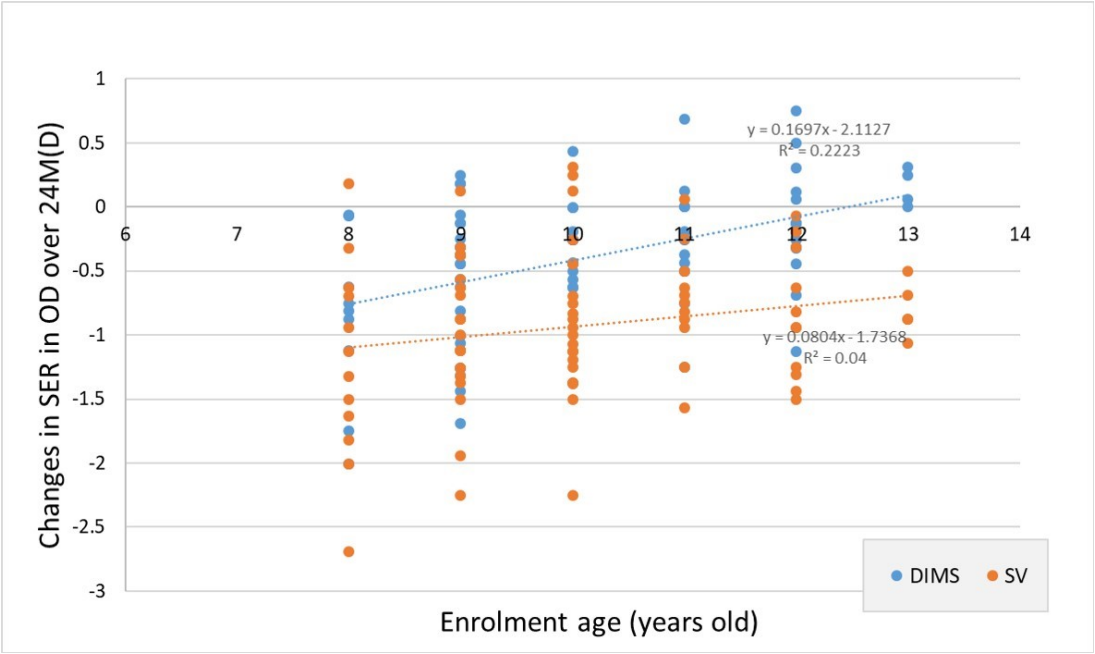


**eFigure 1.** Correlation between myopia progression (spherical equivalent refraction, SER) and age of the subjects at enrolment in the DIMS and SV groups.



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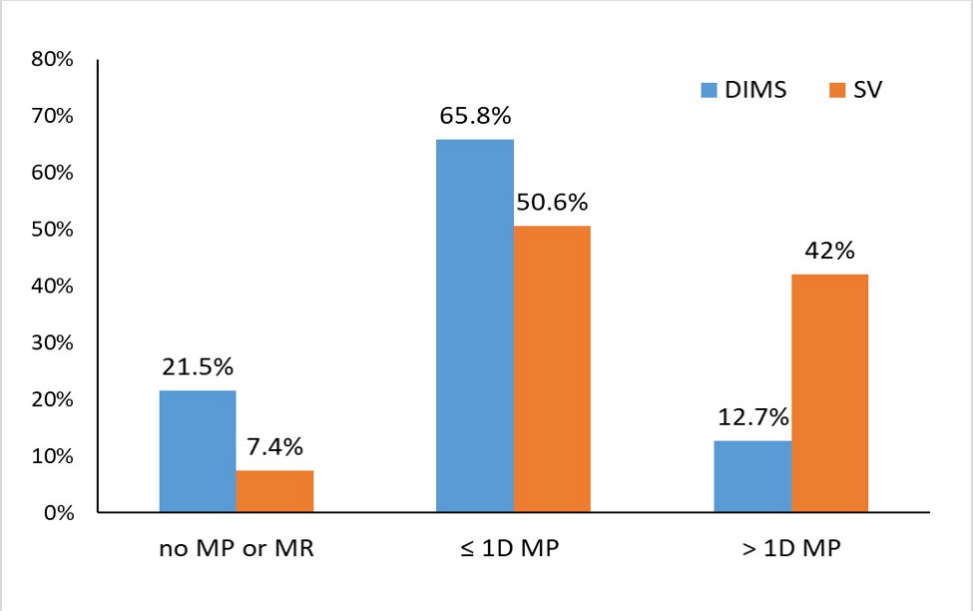
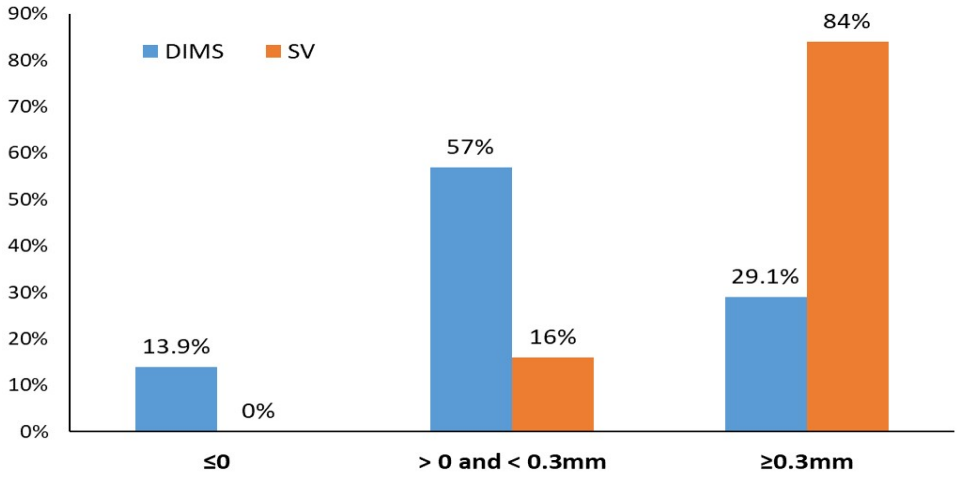



**eFigure 2**. Percentages of the subjects with and without myopic progression at the 24-month visit. MP- myopia progression; MR- myopia reduction.




**eFigure 3**. Percentages of the subjects with and without axial elongation at the 24-month visit.



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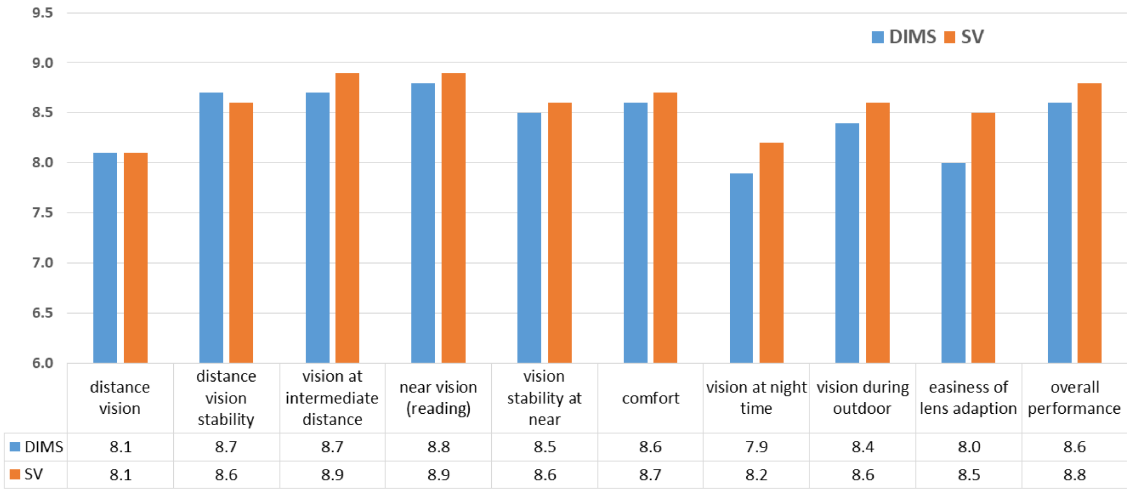
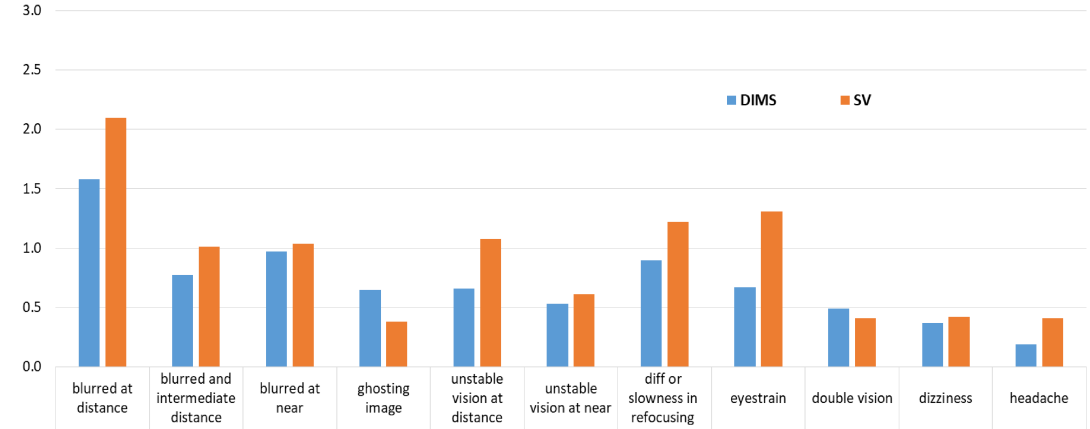



| | distance vision | distance vision stability | vision at intermediate distance | near vision (reading) | vision stability at near | comfort | vision at night time | vision during outdoor | easiness of lens adaption | overall performance |
|---|---|---|---|---|---|---|---|---|---|---|
| DIMS | 8.1 | 8.7 | 8.7 | 8.8 | 8.5 | 8.6 | 7.9 | 8.4 | 8.0 | 8.6 |
| SV | 8.1 | 8.6 | 8.9 | 8.9 | 8.6 | 8.7 | 8.2 | 8.6 | 8.5 | 8.8 |

**eFigure 4.** Subjective responses on lens performance. Scales of scores on lens performance range from 1-10 (the poorest to excellent).




| | blurred at distance | blurred and intermediate distance | blurred at near | ghosting image | unstable vision at distance | unstable vision at near | diff or slowness in refocusing | eyestrain | double vision | dizziness | headache |
|---|---|---|---|---|---|---|---|---|---|---|---|
| DIMS | 1.6 | 0.8 | 1.0 | 0.6 | 0.7 | 0.5 | 0.9 | 0.7 | 0.5 | 0.4 | 0.2 |
| SV | 2.1 | 1.0 | 1.0 | 0.4 | 1.1 | 0.6 | 1.2 | 1.3 | 0.4 | 0.4 | 0.4 |

**eFigure 5.** Reported symptoms while the children were wearing the spectacle lenses. Scales for rating how often the symptoms occur with the lens wear range from 1 -10 (never to always).



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