Wahlberg M, Abdi S, Brautaset R. Treatment of accommodative insufficiency with plus lens reading addition: is +1.00 D better than +2.00 D? Strabismus 2010;18:67-71.

This study from an optometry group in Sweden asked what the effects of +1.00 D and +2.00 D adds would be on amplitude of accommodation and symptoms in subjects with accommodative insufficiency. An expectation of improvement in amplitude of accommodation with wear of a plus add was based on the premise that the plus add would reduce the defocus sufficiently to allow blur sensors to clear the image and regain normal function over a period of time. Subjects had near vision symptoms and a push-up amplitude of accommodation less than 15 D – (0.4)(age). Other subject inclusion criteria served to exclude subjects with vergence disorders, significant refractive conditions, or eye diseases, and subjects who were taking medications known to affect accommodation and binocular function.

Eleven boys and eleven girls within an age range of 7 to 17 years and with a mean age of 11.8 years were recruited as subjects. Subjects had testing of amplitude of accommodation, lag of accommodation, and symptom level before and after eight weeks of wearing either +1.00 D or +2.00 D lens adds. They were instructed to wear the glasses “as much as possible for all types of near visual work and to try to make the image as clear as possible.” (p. 69) Ten subjects in each lens add group completed the study.

Amplitude of accommodation was measured by push-up test using a RAF-rule. Lag of accommodation was determined using MEM dynamic retinoscopy with subjects viewing letters with 6/9 equivalent visual acuity at 40 cm. The level of asthenopia was assessed with a visual analogue scale. Subjects were asked the question: “If 0 equals no problem when doing near work and 10 equals the worst degree of problems, what number would you grade your problem at near work to be now?” (p. 69)

Amplitude of accommodation increased in the ten subjects who wore +1.00 D adds from 6.1 to 9.4 D. This was a statistically significant change (p<0.05). The ten subjects in the +2.00 D add group had mean amplitudes of accommodation of 5.1 D before treatment and 6.4 D after treatment. This was not a statistically significant change.

Lag of accommodation did not show a statistically significant change in either lens group. The mean lags in the +1.00 D add group were 0.50 D and 0.43 D before and after treatment, respectively. Lags of accommodation in the +2.00 D add group averaged 0.37 D both before and after treatment.

There was an improvement in level of asthenopia in both of the groups. In the +1.00 D add group there was a statistically significant change from an average of 5.4 to an average of 2.2 (p<0.05). The +2.00 D add group showed a statistically significant change in the mean symptom level from 7.4 to 1.8 (p<0.001).

The authors noted that the +1.00 D adds resulted in greater improvement in amplitude of accommodation, but that the +2.00 D adds resulted in greater reduction in symptoms over the eight week period. They suggested that the +2.00 D adds gave greater relief of symptoms because they allowed the subject to exert less accommodation, but that the +1.00 D adds required the subjects to exert a little more accommodation and thus regain more
accommodative ability. They recommended +1.00 D adds as a better treatment than +2.00 D adds for accommodative insufficiency “based on the belief that improvement is only achieved if the accommodative mechanism is improved…success should be based on actual improvements in accommodative function and not only short-term relief of symptoms.” (pp. 70-71)


This study was conducted by the same group in Sweden as the paper reviewed above. This study compared the results of 1.00 D plus adds and +1.50/-1.50 D flipper training in the treatment of accommodative insufficiency over an eight period. Subjects had symptoms of asthenopia, blur, and/or headache, and they had a push-up amplitude of accommodation less than 15 D – (0.4)(age). Other criteria excluded potential subjects who had vergence disorders, significant refractive conditions, or eye diseases, and those who were taking medications known to affect accommodation and binocular function.

Subjects recruited for the study averaged 10.3 years of age. Data collected for the study included (1) amplitude of accommodation by push-up method with an RAF-rule, (2) accommodative facility with +2.00/-2.00 D flippers and a row of 6/9 equivalent letters at 40 cm, (3) Nott dynamic retinoscopy with fixation on a row of 6/9 equivalent letters at 40 cm, and (4) a visual analogue scale grading of level of asthenopia, on which the subject was asked the same question as in the study reviewed above.

Fourteen subjects were originally assigned to the lens flipper group, and nine subjects completed eight weeks of flipper treatment. Subjects were instructed to use the +1.50/-1.50 D flippers for two sessions daily. For each session, they were instructed to do as many flips as possible in one minute followed by a one minute break, with repetition such that there would be five of minutes of flipping and four minutes of interspersed breaks per session. The subjects were given a fixation target with 6/9 equivalent letters and told to hold it at 40 cm during the training session. Ten subjects were assigned to the plus add group, and all ten completed the study. They were instructed to use the glasses as much as possible for all near work.

Both study groups showed statistically significant increases in amplitude of accommodation. In the plus add group, mean amplitude changed from 3.6 D (SD=0.8) to 5.2 D (SD=2.2). In the flipper group, mean amplitude was 4.3 D (SD=1.8) before the training and 7.8 D (SD=4.5) after the training.

Neither group had a statistically significant change in flipper rate. The plus add group had average lens flipper rates of 5.6 cycles per minute (SD=3.2) at the start of the study and 6.8 cpm (SD=2.4) at the end of the study. In the flipper group, accommodative facility went from an average of 4.7 cpm (SD=2.4) initially to an average of 6.2 cpm (SD=3.5) after training.

Lag of accommodation from Nott dynamic retinoscopy did not show a statistically significant change in either treatment group. In the plus add group, mean lags were 0.34 D (SD=0.33) before lens wear and 0.30 D (SD=0.41) after lens wear. In the flipper training group, mean lags were 0.32 D (SD=0.44) before training and 0.34 D (SD=0.51) after training.

Both treatment groups had statistically significant reductions in level of symptoms on the visual analogue scale. In the plus add group, mean scale scores were 7.3 (SD=1.0) at the start of the study and 2.6 (SD=0.5) at the completion of lens wear. In the flipper training group, mean scale scores went from 8.1 (SD=0.8) to 1.8 (SD=1.3).

The authors noted that their results showed that both treatment methods resulted in increases in amplitude of accommodation. Their previous studies with the visual analogue scale suggest that a score of 2 or less can be considered normal. Because the average scale score was improved in the plus add group by the end of the eight weeks of study, but it was still above 2 they suggested that the treatment time with plus adds should be longer than eight weeks. They also observed that the fact that all five study drop-outs were from the flipper group “indicates that it may be more difficult to motivate subjects to do orthoptic exercises as compared to wearing reading glasses.” (p. 69)


This study was conducted by an ophthalmology group at the University of Bologna in Italy. The authors noted that the ophthalmology literature had
shown that esotropia was often accompanied by a low amplitude of accommodation. The authors performed the study to examine whether the low amplitude of accommodation was present before treatment or whether it could be the result of the use of bifocal lenses.

There were two groups of study subjects. The esotropia group consisted of 28 consecutive patients, 17 females and 11 males, with ages from 5 to 8 years (mean age, 6.3 years). They were said to be “orthophoric for far,” but with esotropia at near. The esotropia subjects were said to be “emmetropic or mildly hypermetropic” with 17 having 1.25 to 2.00 D of hyperopia and six having 2.25 to 3.00 D of hyperopia. The mean gradient AC/A ratio in the esotropia group was 9.0 Δ/D, and the range of gradient AC/A ratios was 6 to 11 Δ/D.

A control group consisted of 20 females and 8 males who were “orthophoric for far and near,” and who were 5 to 8 years of age, with a mean age of 6.0 years. They had a similar distribution of refractive conditions with 20 having 1.25 to 2.00 D of hyperopia and three having 2.25 to 3.00 D of hyperopia. The mean gradient AC/A ratio in the control group was 3.0 Δ/D. Astigmatism was no more than 1.25 D in either group.

Amplitude of accommodation was determined by the push-up method. It was performed monocularly in a phoropter using a test card on a reading rod. The measurement was performed three times and the average of the three values was used in the analysis. Amplitude of accommodation measurements were taken before the esotropia group started wearing bifocal lenses and again after four years of wearing bifocals. The add power in the bifocals was not stated. The control group had amplitude of accommodation determined before and after a four year period of time.

In the control group, the mean amplitude of accommodation at the beginning of the study was 10.96 D with a standard deviation of 1.17 and a 95% confidence interval of 10.51 to 11.42 D. After four years, the mean amplitude of accommodation in the control group was 10.68 D with a standard deviation of 0.94 and a 95% confidence interval of 10.31 to 11.04 D.

In the esotropia group, the mean amplitude of accommodation before bifocal lens wear was 8.93 D, with a standard deviation of 1.74 D and a 95% confidence interval from 8.25 to 9.60 D. The authors noted that the amplitude of accommodation was low before the bifocals were worn rather than being the result of bifocal wear.

Comments
Three studies that presented data on the effect of plus adds on amplitude of accommodation in children were reviewed here. In two of the studies, plus adds were worn for eight weeks by subjects with accommodative insufficiency. In both studies amplitude of accommodation increased with plus lens treatment. In yet another study by the same Swedish group, three accommodative insufficiency subjects with accommodative amplitudes of 4 to 6 D served as controls and still had amplitudes in that range after eight weeks of no treatment. In comparison, ten subjects in that study treated with +1.00 D adds all had their amplitudes increase from less than 6 D to 10 D or more after eight weeks. Though the number of controls was small, the findings with the control subjects may obviate the potential criticism of the studies reviewed here that amplitude measurements were taken by subjective means and could be subject to placebo effects. It is interesting to note that even though the first two studies reviewed showed increases in amplitude of accommodation with +1.00 D adds and with flipper training, neither treatment resulted in a change in the lag of accommodation.

References