

# Literature Review: Children and Contact Lenses

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## Abstract

*Fitting contact lenses in the pediatric population can be rewarding for both the child and practitioner. Contact lenses as an option for vision correction can have a major impact on a child's life and visual development. Progressive myopia is a detrimental and visually debilitating condition. With recent focus on the use of different contact lens modalities, continuous progress is being made in attempting to halt myopia progression in children. Promising results have been found in early trials with use of Dual-Focus lenses. With the advent of improved contact lens materials, the question of whether it is possible to fit younger children has been raised. Recent studies have found fitting children with contacts has minimal risk of adverse events, does not require more of the practitioner's time and can improve a child's self-perception. This review takes a look at three studies involving contact lenses and children.*

## Key Words

*ACHIEVE Study, CLIP Study, contact lenses, children, DIMENZ, Dual Focus Contact Lenses, myopia*

### **Anstice NS, Phillips JR. Effect of Dual-Focus Soft Contact Lens Wear on Axial Myopia Progression in Children. *Ophthalmology* 2011;118:1152-61.**

Many studies have been conducted to find a way to slow the progression of myopia. These studies have included using monovision contact lenses, progressive addition lenses and atropine. All techniques have produced promising results, but come with their own limitations. The Dual-Focus Inhibition of Myopia Evaluation in New Zealand (DIMENZ) study sought to determine the effect of peripheral defocus with a simultaneous viewing of a clear central image on slowing the progression of myopia in children using Dual-Focus (DF) soft contact lenses.

A total of 40 children, age 11-14 years old, were enrolled. The range of spherical equivalent refraction (SER) as measured with non-cycloplegic refraction, was between -1.25 and -4.50D in the less myopic eye. Requirements included an increase in myopia by  $\geq 0.50$  D in the past year, best corrected visual acuity of Snellen 6/6 (20/20) or greater in each eye and at least eight hours of contact lens wear time over the course of the study. Exclusions included strabismus,  $\geq -1.25$ D of astigmatism,  $\geq 1.00$ D of anisometropia, ocular or systemic pathology that could limit contact lens wear of refractive maturation or birth weight of  $\leq 1250$ g.

The study spanned 20 months and consisted of two 10-month periods: period 1 and period 2. Study participants were randomly placed into two groups. Group 1 was selected to wear DF soft contact lenses initially in the dominant eye and a single vision distance (SVD) lens in the non-dominant eye for period 1. This was then reversed for period 2 to avoid inducing anisometropic changes. Group 2 followed the same plan, but the opposite wearing sequence.

The specifically designed DF lenses had a central correction zone with a dioptric power matching the subject's specific refractive error. This allowed for consistent clear central vision during both distance and near tasks. This central zone was surrounded by a series of treatment rings and correction zones creating two focal planes, thus establishing peripheral defocus. Treatment zones created 2.00D of simultaneous myopic retinal defocus, whether viewing a distance or near target. Pupil measurements were taken for each patient to make sure that the correction zone was large enough to stimulate accommodation, provide stable central vision and ensure that the treatment zone remained within the pupil during near tasks under both photopic and mesopic conditions.

The contact lenses were fit and dispensed at the baseline visit with follow up scheduled in two to three weeks. SER, axial length (AXL) measurements and corneal power (CP) were taken at the baseline visit followed by every five months for the next 20 months. Compliance was monitored at each visit. Contrast sensitivity measurements were only obtained at the five month visit using a Pelli-Robson chart. Accommodative responses were measured to ensure that the children were not using the treatment zones in the DF contact lenses as a bifocal addition.

Analysis of baseline measurements showed no significant differences in SER, AXL or CP between those wearing DF or SVD lenses in the two groups or within the groups. Thirty-five children completed the first 10 months and 34 completed the last 10 months of measurements. There was no difference in contrast sensitivity measurements between the eyes wearing DF and SVD lenses, and visual acuity did not change significantly throughout the study. By the end of the 20 month period, the children reported wearing the contact lenses for an average of 13.15  $\pm$  2.80 hours/day, and 27 of 34 subjects wore the lenses seven days of the week. The remaining

seven children wore the contact lenses six days of the week. There was no statistical difference in wearing times between the groups.

During period 1, the mean increase in myopia in the eyes fit with DF lenses was reduced by 37% compared to those wearing SVD lenses. In relation to eye elongation, the mean increase in AXL was reduced by 49% in those eyes fit with DF lenses compared to SVD lenses. In period 2, both the increase in myopia and AXL was less in the eyes wearing DF lenses compared to those wearing SVD lenses, but at this stage it is unknown what the cross-over effect has on these two measurements. Over the course of the entire study the mean CP increased slightly from 43.77 +/- 1.24D to 43.84 +/- 1.20 D, but there was no difference found in those wearing DF lenses and SVD lenses in both of the periods. Changes in CP were also found not to be a factor in the difference in the progression rates with DF and SVD lenses. No significant difference was found in treatment outcomes whether the eye was fit with a DF or SVD contact lens on the dominant or non-dominant eye. When comparing gender in period 1, there was no difference in myopia progression. During the first period, boys showed a greater change in AXL than girls in eyes wearing the SVD lens. This was not the case when wearing DF lenses. This correlates to previous reports that boys normally have a greater eye size growth with age than girls.

Progression was difficult to compare among the children due to a wide range of refractive error changes. The changes in refraction and axial length were plotted for eyes wearing the DF lens against the contralateral eye with the SVD lens for each individual. Comparing the paired-eye data for each individual allowed the percent reduction in myopic progression with DF lenses to be computed for each subject. It was found in period 1 that myopia progression was decreased by 70% in 30% of children, decreased by 50% in >= 50% and decreased by 20% in >= 70% in the eye fit with the DF lens compared to the eye fit with the SVD lens. The analysis of period 2 data provided similar results.

This study shows that the specific design of the DF lens creates and maintains peripheral myopic defocus. This constant myopic defocus has a significant impact on the reduction of myopic refractive error and elongation of the eye. Limitations included a relatively short time period for the study and that the results of wearing DF lenses under bilateral conditions were not investigated. This study shows that the progression of myopia can be slowed with sustained peripheral myopic defocus, even in the presence of a simultaneous clear image. With the use of DF contact lenses, maximum visual acuity and normal contrast sensitivity can be maintained. Further work needs to be done to determine if these results can be sustained over time and therefore become a promising and viable answer to halting myopia progression.

**Walline J J, Jones LA, Rah M J, Manny RE, et al. Contact Lenses in Pediatrics (CLIP) Study: chair time and ocular health. *Optom Vis Sci* 2007;84:896-902.**

It has been found in previous studies that children 8-11 years old are able to successfully wear contact lenses with few adverse effects, but many practitioners are still hesitant to suggest contact lenses to younger patients. This portion of the

Contact Lens in Pediatrics (CLIP) study investigated whether there is an increase in chair time needed to fit a child 8-12 years old compared to a teenager 13-17 years old.

A total of 84 children and 85 teens were enrolled. Subjects had best corrected visual acuity 20/25 or better, no ocular health conditions to contraindicate contact lens fitting, and had not previously worn contact lenses. Noncycloplegic subjective refractions were performed with refractive errors ranging from +5.00 D to -9.00 D and <-2.25 D of astigmatism. The subjects were fit with contact lenses at the baseline visit and insertion and removal (I & R) training was performed. Each subject had to be able to remove and insert the contact lenses three times before the contacts were dispensed. Additional visits were provided if necessary for further training and were included in the overall fitting time. Follow up visits were conducted at one week, and one and three months. At each visit, high-contrast logMAR visual acuity at four meters, over-refraction when necessary, contact lens fit assessment and biomicroscopy were performed. Slit lamp evaluation included an assessment of corneal and conjunctival staining, bulbar redness and limbal redness. These were recorded on a scale from 0-4 using the Cornea and Contact Lens Research Unit (CCLRU) standards. The cornea was also examined for the presence or absence of infiltrates, microcysts, neovascularization and corneal edema.

Practitioners' ability to predict which children were capable of contact lens wear was assessed by asking the practitioner's opinion of whether the subject could be fit and learn I & R prior to the start of the exam based on first impression. The practitioners were given the options of: "extremely easy," "easy," "difficult" and "extremely difficult."

The total time of fitting the contact lenses, I & R training and follow up visits were recorded and added together to obtain the total chair time for each subject. For young children and teens, the mean total chair time was calculated to be 110.6 +/- 39.2 min and 95.3 +/-25.2 min, respectively. This is a significant difference between the two age groups, but when broken down, the major difference was due to time taken for I & R training. Young children took 41.9 +/- 32.0 min while teens took 30.3 +/-20.2 min to complete I & R training. The two groups had similar mean refractive errors, corneal curvature, and similar distribution of gender, ethnicity and family member in glasses. There were no major differences found between the two age groups when looking at biomicroscopy changes with contact lens wear. The only sign to significantly increase was conjunctival staining from baseline to the three month follow up, which occurred in both groups. A total of five nonserious adverse events occurred in which lens wear was discontinued for a short period of time with complete resolution of the problems. There were no significant differences found in adverse events between the children and teens. Regression analysis showed that doctors were able to pick out which patients would require more time. Practitioners suggested looking at hygiene, parental and patient motivation, anxiety, maturity and aperture size as a way of determining ease of the possible fit.

The study concluded that younger children take approximately 15 minutes longer chair time than teens, but the major difference was spent teaching I & R. The authors of the study

noted that since I & R training is mostly performed by staff, the actual practitioner's time spent is approximately the same between children and teens. This information, along with previous studies, emphasize that contact lenses are a viable option for primary vision correction with children as young as 8 years old.

**Rah MJ, Walline JJ, Jones-Jordan LA, Sinnott LT, et al. Vision specific quality of life of pediatric contact lens wearers. *Optom Vis Sci.* 2010; 87, 560-566.**

This specific portion of the Adolescent and Child Health Initiative to Encourage Vision Empowerment (ACHIEVE) study was designed to determine the impact of contact lens versus spectacle wear on a child's self-perception. This article examined the advantages of wearing contact lenses versus glasses over a period of three years on a child's vision specific quality of life.

A total of 484 spectacle-wearing children between the ages of 8 and 11 were enrolled at five separate clinical sites for evaluation over a period of three years. The examiners quantified a subject's perception of self using the Pediatric Refractive Error Profile (PREP). This specific survey was chosen since it focuses on vision specific pediatric quality of life. This survey distinguishes between spectacle wear and contact lens wear and consists of 26 statements to be scored on a scale of 1 (poor quality of life) to 5 (good quality of life). Each child in the study completed the survey with no help from a parent. There were a total of 11 scales in the survey: Activities, Appearance, Far Vision, Near Vision, Handling, Peer Perception, Satisfaction, Academics, Symptoms, Overall Vision and Overall PREP. Each subject was given the PREP at the baseline visit and then randomly chosen to wear either contact lenses (n=247) or glasses (n=237) for the next three years. The children completed the survey at the baseline exam, at one month and every six months for three years. Participants had spherical refractive errors between -1.00 and -6.00D and no more than 1.00D of astigmatism measured with cycloplegic autorefraction. Children that wore contact lenses within a month of the initial visit or had global stereo acuity  $\geq 250$  sec of arc were excluded. All subjects obtained best corrected vision of 20/20 or better in both eyes. For those randomly chosen to wear contact lenses, examinations were performed at one week, one month, six months and 12 months. Over the following two years, the children presented for examination every six months, with dilation and new spectacles or contact lenses provided at each yearly visit. The PREP survey was completed at every visit except for the one week contact lens

follow up. There were no statistically significant differences between the groups at baseline.

The results after the first month showed the biggest change. In those wearing contact lenses, the Activities, Appearance and Satisfaction with Correction scales improved by at least 25 points. At the conclusion of the study the same three scales showed improvement of at least 23 points or more among the contact lens wearers. In the spectacle group there was no scale that showed an improvement of greater than 10 points during the first month and no more than 5 points in any area at the conclusion of the study. Sex, spherical equivalent refractive error and site location did not have any statistically significant effects on the PREP scales. The Academic scale score was not affected by contact lens or spectacle wear, but did increase every year as age increased.

Older children improved considerably more than younger children in all scales except for those relating to visual performance. This suggests that those older than 10 years old may have a greater improvement in the various areas of quality of life. One interesting finding was that the children in the study responded with an improvement in quality of life in terms of handling contact lenses over spectacles. This was somewhat unexpected since they had to learn I & R, but is likely due to no longer having to worry about breaking or losing their glasses.

The overall quality of life measured by the PREP was raised by 14.2 +/- 18.1 units for those wearing contact lenses versus 2.1 +/- 14.6 for spectacle wearers. The contact lens wearers had much greater improvements in vision specific quality of life in the areas of Appearance, Athletics and Satisfaction with correction.

The examiners concluded that the best pediatric candidates for contact lens fits are those involved in recreational activities or those who do not like to wear glasses on the basis of appearance. This can have a major impact on a child's motivation to wear vision correction, as well as their developing self-confidence.

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