

ORTHOKERATOLOGY

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Orthokeratology, also referred to as ortho-K, is defined as: "A procedure designed to affect the reduction or elimination of refractive anomalies by the programmed application of contact lenses". More simply, the concept of re-shaping the refractive window of the eye, the cornea, by flattening its curvature with rigid contact lenses.

The purpose of this study is to reduce my myopia as well as some induced cylinder acquired from wearing "hard" PMMA contact lenses for seven (7) years.

I am currently 23 years old with a significant amount of with-the-rule astigmatism in both eyes. When I was 13 years old, I was a simple myope with no astigmatism reported. I was fitted with spherical "hard" PMMA contact lenses. This PMMA material had insufficient oxygen transmission for my cornea and due to the overwearing of these lenses (16 - 18 hours a day for seven years), my cornea went under some of its own physiological changes. The with-the-rule cylinder developed after I discontinued wear and even though most patients return to their baseline corneal readings after they stop wearing PMMA's, my ex-spherical cornea had its own ideas and the cylinder stayed with me.

The next step is to decide on the method of treatment to be used. Different methods of ortho-K have been developed by various practitioners, and certain variables have to be taken into account upon deciding how to fit these lenses. These things are:

- 1) Length of wearing time - Four to six hours of daily wear is suggested for -1.50 diopters (D) of myopia and less. If more is present, then you simply increase your daily wearing schedule.
- 2) Base curve of contact lens - This should be equal or up to 1.00 D flatter than the curvature of the cornea in the horizontal meridian. The vertical meridian will tend to flatten slightly with this type of fit, but we are primarily working towards flattening the horizontal curvature. A base curve of more than 1.00 D flatter than the horizontal will result in steepening the vertical meridian which will cause induced with-the-rule cylinder.
- 3) Overall diameter of contact lens - This aspect of the fitting is not as important in flattening the cornea as the length of wearing time or base curve. Studies do show that a larger overall diameter can produce more flattening in the vertical meridian than a smaller lens (for example, 9.5mm dia. vs. 8.5mm dia.), but at the same time, a larger lens also causes more corneal distroction (increased with-the-rule cylinder) than a smaller lens.

Determined to eliminate any myopia I could, I accepted the challenge of ortho-K and began the study. On July 1, 1985, I recorded by baseline corneal readings:

	<u>OD</u>	<u>OS</u>
Unaided VA's	20/400	20/400
Refraction-BVA	-2.75--2.75x180 20/15	-2.00--3.75x005 20/15
Keratometry	43.75 @177/46.25 @087	43.50 @005/46.25 @095
Intra-palpebral fissure	11mm	11mm
Corneal health	<u>WNL</u>	<u>WNL</u>

I ordered Paraperm gas permeable contact lenses for this study with parameters to meet the criterion and be effective for ortho-K. I chose to record my corneal readings at one, three, and six month intervals. If I was not satisfied with my results after six months, then changes in the lenses were going to be made:

<u>Parameters</u>	<u>OD</u>	<u>OS</u>
BC	7.76mm(0.25D flatter than K)	7.76mm (equal to K)
CT	0.14mm	0.14mm
OAD	9.0mm	9.0mm
Power	-2.50D	-2.00D
DK-value	12 x 10 -11	12 x 10 -11

I wore these lenses 6-8 hours a day for 6 months. The comfort of these lenses was never satisfactory or I would have worn them longer during the day. The data is listed to show my progress at each of the three different time intervals:

<u>1 Month</u>	<u>OD</u>	<u>OS</u>
# of hours worn that day	7 hrs.	7 hrs.
Unaided VA's	20/200	20/200
Refraction-BVA	-2.50=-2.75x175 20/15	-2.00=-3.50x003 20/15
(spectacle blur was never a significant problem because of decreased wearing time)		
Keratometry	43.50 @180/46.12 @090	43.50 @180/46.00 @090
Over-refraction	+0.50=-1.00x010	+0.25=-1.25x002
Flexure	1.00 D	1.25 D
Corneal health	WNL - no changes	WNL - no changes

<u>3 Month</u>	<u>OD</u>	<u>OS</u>
# of hours worn that day	8½ hrs.	8½ hrs.
Unaided VA's	20/200	20/200
Refraction-BVA	-2.50=-2.50x177 20/15	-1.75=-3.25x180 20/15
Keratometry	43.37 @180/46.00 @090	43.25 @003/46.00 @093
Over-refraction	+0.50=-1.00x010	+0.50=-1.25x180
Flexure	1.25 D	1.50 D
Corneal health	WNL - no changes	WNL - no changes

<u>6 Month</u>	<u>OD</u>	<u>OS</u>
# of hours worn that day	8 hrs.	8 hrs.
Unaided VA's	20/200	20/200
Refraction-BVA	-2.50=-2.50x177 20/15	-1.75=-3.25x180 20/15
Keratometry	43.37 @180/45.87 @090	43.25 @180/46.00 @090
Over-refraction	+0.50=-1.00x007	+0.50=-1.25x180
Flexure	1.00 D	1.50 D
Corneal health	WNL - no changes	WNL - no changes

The results after 6 months of wear were very disappointing. I expected more of a decrease than this and optioned to change some parameters. I did stick with Paraperms but significantly changed 2 things in my lenses. I chose to make the base curves much flatter than the previous pair and increase the DK-value to possibly improve the comfort so I could increase my daily wearing time.

I discontinued wear of any contact lenses for one month and regressed some but not all the way to my baseline readings. Given below are my readings after 1 month of no contact lens wear and the new parameters ordered:

<u>Feb. 1, 1986</u>	<u>OD</u>	<u>OS</u>
(No contact lens wear for 1 month)		
Unaided VA's	20/200	20/200
Refraction-BVA	-2.75=-2.50x180 20/15	-1.75=-3.50x003 20/15
Keratometry	43.50 @002/46.00 @092	43.25 @180/46.25 @090
Corneal health	WNL	WNL

<u>Parameters-2nd pair</u>	<u>OD</u>	<u>OS</u>
BC	7.90mm(0.75D flatter than K)	8.00mm(1.00D flatter than K)
OAD	8.8mm	8.8mm
(I decided to stay with a medium diameter lens. It is an intra-fissure fit for me, just like the first pair. This way, I avoid the problem of corneal distortion caused from a real large diameter, but it is still big enough to have a flattening effect on the vertical meridian).		
CT	0.18mm	0.18mm
Power	-2.50 D	-1.75 D
DK-value	56 x 10 -11	56 x 10 -11

This ortho-K study is somewhat controversial because only one patient is involved, but there are still some valid points that can be derived from this study. First, wearing time plays a vital role in ortho-K. The first six months of this study shows that 6-8 hours of daily wear is not enough to have any significant flattening effect on my cornea. Again, a different cornea might have flattened more than mine, and this is the drawback of this type of study. Flexure and low DK-value were responsible for the decreased wearing time and changes in these in the second pair enabled me to wear the lenses twice as long on a daily basis. Next, I feel that having a base curve at least 0.50 D flatter than K is more successful than fitting right on K. This is secondary in my study because I use decreased wearing time as the main reason for my lack of success, but it did play a role in my six week reduction. Finally, I would like to mention the stability of ortho-K. Most ortho-K studies show that patients go back to baseline readings without wearing a retainer contact lens a certain period each day to maintain the desired corneal curvature. In my situation, I didn't have enough of a decrease with my first pair of lenses, and then ran out of time in this study to see if my recent progress would remain. I never expected to be corrected to 20/20 without any lenses and planned on wearing a retainer lens to keep my refraction stable as well as provide the necessary power to achieve maximum acuity. It only makes sense to me that if you do achieve success in myopia reduction that you would want to wear retainer lenses to keep that success.

I think ortho-K is for real and that the last six weeks of this study showed that I'm on the right track. I don't feel that I've peaked yet and that more myopia can be reduced. I am more concerned with overall reduction rather than just reducing the cylinder at this time. I'm going to continue wearing these lenses until my base curves are only 0.37 D flatter than my K-reading. At that time, I'll order new lenses and change the base curve to 0.75 D flatter than K.

I don't feel that ortho-K will work for everyone but I would recommend this idea to certain patients. The "ortho-K" patient should be myopic, highly motivated, preferably a previous rigid contact lens wearer, and well-educated about the procedure and the results to be expected.

In conclusion, orthokeratology is a safe way to reduce myopia. There is no increased risk to corneal integrity as compared to regular gas permeable lens fits. This study also demonstrates that wearing time and base curves with respect to K are important factors in reducing myopia, while inconclusive evidence is shown about the stability of ortho-K. I feel this procedure should be considered and can be a great service to offer to your patient as well as a tremendous practice builder.

- (1) "Orthokeratology" - Dr. John Pole, O.D., Ferris State College of Optometry, February, 1985.
- (2) "Why Ortho-K?" - Dr. Ned Paige, O.D., Contact Lens Forum, November, 1985.
- (3) "A Simple Procedure to Improve Results in Orthokeratology and Regular Contact Lens Practice" - Dr. Ned Paige, O.D., International Contact Lens Journal, Volume 27, Number 4, July, 1983.
- (4) "Orthokeratology - A Retrospective Study of 75 Cases" - Dr. Ned Paige, O.D., Dr. Karen L. Mustaler, O.D.
- (5) Dr. Kris Smith, O.D., Jackson, Mi.