NIGHT AND DAY RETAINER LENS USE BY ORTHOKERATOLOGY PATIENTS

OPT IV RESEARCH PROJECT
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INTRODUCTION

Orthokeratology, or ortho-K, is a term applied to a method of corneal molding using rigid gas permeable contact lenses to decrease the amount of myopia a patient has , as well as decreasing the amount of astigmatism. Orthokeratology technology has been in use since the mid-1950's, but is just beginning to get more notoriety due to the popularity today of other corneal molding techniques (e.g. radial keratotomy and laser molding). In this study, we looked at a specific portion of the ortho-K program/technique, the retainer lens, in the hopes of determining which wearing schedule, day wear or night wear, is superior. We also hope to determine just how well the retainer lens works, especially as it relates to the varying degrees of myopia.

The technology for orthokeratology has been around since 1955 and was pioneered by Dr. George Jessen (of Wesley-Jessen Contact Lenses). His ideas were expanded and improved upon to give us the ortho-K lens design we see today. Orthokeratology uses rigid gas permeable fit with the base curve 1 to 3 diopters flatter than the central K readings. An ortho-K lens also has a peripheral base curve that is steeper than the central base curve. This steeper peripheral curve is employed to " bunch up " the corneal tissue helping to sphericalize the central cornea while the flat base curve flattens the cornea. This molding of the cornea effectively decreases both the amount of astigmatism and myopia. The process of myopia control occurs within approximately five months, changing lenses 3 to 5 times to achieve the desired corneal shape/refractive error.

Once the desired endpoint is reached, the patient is fit with a retainer lens that is essential for corneal molding maintenance. The retainer lens is worn for only a few hours everyday or every other day, either during the day or while the patient sleeps.

The benefits of orthokeratology over other corneal techniques are that ortho-K is a completely noninvasive, reversible technique. If the patient is not satisfied with their vision at the conclusion of the program, they stop wearing the retainer lens and their cornea will return to it's original topography. Ortho-K is also much less expensive than radial-K or laser molding and involves no pain, drugs or surgical procedures.

METHODS

The methods used in this study were designed and accomplished at Ferris State College of Optometry in Big Rapids, Michigan, under the guidance of Dr. Donald Lakin. Originally, twenty-one people were fit with a custom designed ortho-K lens. These lenses were replaced with newer lenses until the desired corneal topography/refractive error was reached on each patient. At this time a retainer lens was designed, ordered, and dispensed to the patient. Of the original 21, only eight patients had a sufficient amount of data to be used in this portion of the study.

At the time of the retainer lens dispensing, a visual acuity chart (used at 10 feet) and a log were also dispensed to the patient. These were to be used by the patient to test their vision prior to insertion of the retainer lens and immediately upon removal of the retainer lens. The patients were to then record the results for their right eye, left eye, and both eyes together in the supplied log whenever the lenses were worn. The time of insertion and the time of removal were also to be recorded next to the patients visual acuity.

The data collected was calculated on a per patient basis due to the difference in recording from patient to patient. Some patients recorded OD, OS and OU visual acuities, but some patients recorded only OD and OS visual acuities (and in one case only OU values for the first half of their retainer wearing time).

The data collected from each patient was done so by choosing ,at random, 15 days from each patients log spanning the entire retainer wearing time. In one case, a sample of only 10 was used due to a severe lack in recording consistency by one patient. The raw data from each day was compiled and an average visual acuity prior to insertion of the retainer lens and upon removal was calculated. Also calculated were the average wearing time per patient and the average change in visual acuity (from before insertion to after removal of the retainer lens) for each patient from the chosen sample.

It is from this calculated data that I draw my conclusions at the end of this study.

RESULTS

As stated before, the following four numbers were calculated for each patient from the chosen sample: 1) the average visual acuity prior to the insertion of the retainer lens (In Ave.), 2) the average visual acuity immediately following removal of the retainer lens (Out Ave.), 3) the average time the retainer lens was worn (Ave. Time) in hours, and 4) the average change in visual acuity (Ave. Change) as a function of the increase/decrease of the number of lines of acuity. The raw data for each patient can be seen in Tables 1 through 8, while Table 9 shows a composite of the four above mentioned categories.

Of the eight individuals in the study, 4 (50%) achieved an Out Ave. of 20/20 or better and 6 of the 8 achieved an Out Ave. of 20/30 or better. All but one of the eight patients achieved an Out Ave. of 20/40 or better, and that one individual did not keep good records indicating a possibility of poor following of the wearing schedule.

When comparing day wear to night on an Out Ave. basis only, the night wearing schedule appears to be slightly more favorable with an approximate Out Ave. of 20/25 for those patients wearing their retainer at night. The day wear schedule patients had an Out Ave. of approximately 20/30 with two attaining 20/16 vision. This data is demonstrated in Tables 10a and 10b.The calculated also shows that better results are achieved in individuals with lower amounts of myopia and astigmatism to begin with. All (100%) of the low myopes achieved Out Ave.s of 20/20 or 20/16. For the basis of this study, a patient was considered a low myope if their starting correction was 2 D of myopia or less. A patient was considered a moderate myope if their starting correction was from 4 D to 2 D. There were no high myopes in this study. Tables 11a and 11b shows the comparison between the low myopes and the moderate myopes.

DISCUSSION

The data showed that even though the night wear schedule achieved slightly better results, it was so close that patient convenience or doctor preference should be the determining factor as to which wearing schedule to choose. Also, this data may be slightly skewed due to the fact that most night schedule patients in this study were also low myopes (3 of 4).

A comparison between wearing time and change in visual acuities prior to and after removal of the retainer lens was attempted. But due to a lack of uniform recording among the participants, the results did not lend themselvesto statistical analysis. Future studies may show a correlation between wearing time and final visual acuity.

Orthokeratology is a viable option for today's optometrist in response to the present onslaught of refractive surgery hype by ophthalmologists. Ortho-K is a completely noninvasive, nonpainful and less expensive option to radial-K and laser surgery. But, patients must be chosen carefully and explained to, in detail, what is required of the patient (as far as total program length and office visits) for orthokeratology to be successful. This being done, there is no reason for an optometrist not to utilize this technique and use it to expand their scope of practice.

This portion of the study did use an admittedly small sample size. But it is felt that some very useful and valuble information is obtained from it. It is also felt that perhaps the degree of unreliable recording in the log is due to it being just too demanding a task.

There are other studies being done at Ferris State involving other areas and aspects of the ortho-K program. Perhaps with these, and future studies, ortho-K will find it's place on todays optometric therapy.

REFERENCES

1. National Eye Research Foundation information packet.
2. Ortho-K Patient/Doctor Information Pamphlet published by the National Eye Research Foundation.
3. Dr. Richard J. Wlodyga lecture information given at a April 25, 1993 ortho-K seminar sponsored by NERF and IOS.

In this study, patients involved were asked to keep a daily log as a record of their progress in the study. A part of this log was to record their visual aciuties as a measure of success. To make it easier on the patient, and to promote uniform recording from patient to patient, a numbering system was utilized with a number corresponding to a Snellen visual acuity equivalent. This numbering system was used throughout the tables in this study. The numbering system, along with it's Snellen equivalent, is presented below and is to be used to translate the following tables:

Number	Snellen equivalent
1	20/16
2	20/20
3	20/25
4	20/30
5	20/40
6	20/50
7	20/60
8	20/80
9	20/100
10	20/125

Table:1
Pt Name:Andy Baldus
Wearing Schedule:Day
Degree of Myopia:Moderate
Starting Rx:-3.00 -.50 x 060
-3.00 -.75 x 105

Date	In	InAve	Out	Out Ave	Change	Total Time
5/24	9a	9	5p	4	5	8
5/25	8a	9	7p	4	5	11
5/26	8a	9	7p	4	5	11
8/30	8a	10	5p	7	3	9
9/4	4p	10	11p	8/7/6	4	7
9/5	9a	10	3p	8/8/7	3	6
9/6	3p	10	5p	7/8/7	3	2
9/7	7a	10	4p	7/7/6	4	9
9/8	7a	10	1p	6/6/5	5	5
9/9	1p	10	10p	7/7/6	4	9

n=10
In Ave.:9.7
Out Ave.:7.2/7.2/5.6
Ave Time In:7.7
Ave Change:4.1

For this patient I only compared OU results due to a lack of informaton in earlier recording.

Table:2
Pt Name:Catherine Buchanan-Dorrance
Wearing Schedule:Night
Degree of Myopia:Low
Starting Rx:-1.50 -.25 x 085
-1.50 -.25 x 083

Date	In	InAve	Out	Out Ave	Change	Total Time
5/19	1130p	3/2/3	12p	1/1/1	2/2/1	11.5
6/9	11p	1/5/1	8a	1/1/1	0/4/1	9
6/22	1115p	1/1/1	815a	1/1/1	0/0/0	9
7/9	12a	2/1/1	830a	2/1/1	0/0/0	8.5
7/28	12a	2/2/2	930a	3/2/2	1/0/0	9.5
8/2	1030p	3/4/1	915a	3/1/1	0/3/0	7.25
8/3	1215a	2/3/2	930a	3/1/1	-1/3/1	11
8/10	12a	2/4/3	830a	2/1/1	0/3/2	8.25
8/19	1145p	4/3/2	12p	1/1/1	3/2/1	12.25
8/26	1230a	2/4/2	12p	2/3/2	1/1/1	11.5
8/31	1230a	4/4/3	12p	1/2/1	1/2/1	11.5
10/11	1230a	3/2/2	12p	2/1/1	2/3/2	11.5
10/13	12a	2/1/1	12p	2/1/1	0/0/0	11.5
10/14	1230a	2/3/2	11a	1/1/1	1/0/0	11
10/19	2a	3/4/3	1115	1/1/1	1/2/1	10.75

n=15
In Ave.:2.4/2.6/1.9
Out Ave.:1.7/1.3/1.1
Ave Time In:10.3
Ave Change:.9/1.7/.8

Table: 3
Pt Name:Brenda Chadwick
Wearing Schedule:Day
Degree of Myopia:Moderate
Starting Rx:-3.25 sph
-2.75 sph

Date	In	InAve	Out	Out Ave	Change	Total Time
5/24	830a	8/8/7	2p	6/5/6	2/2/1	5.5
5/26	830a	8/8/7	1220p	6/6/5	2/2/2	4
6/2	815a	7/7/6	315p	5/4/4	2/3/2	7
6/10	9a	7/7/6	11p	3/4/3	4/3/3/	14
6/16	1a	7/7/6	1p	4/4/4	3/3/2	12
6/22	8a	7/8/7	11p	4/5/4	3/3/3	15
7/22	815a	7/7/6	445p	6/6/5	1/1/1	8.5
7/28	1030a	6/6/5	1145p	4/5/3	2/1/2	13.25
8/10	130p	6/6/5	7p	4/4/3	2/2/2	5.5
8/17	9a	6/6/6	7p	4/4/3	2/2/3	10
9/20	910a	7/7/6	415p	4/4/3	3/3/3	7
10/19	930a	7/7/6	5p	4/4/3	3/3/3	7.5
11/13	9a	7/7/6	7p	4/4/3	3/3/3	10
11/20	10a	7/6/5	8p	4/3/3	3/3/2	10
12/1	930a	7/6/5	1030p	3/4/3	4/2/2	13

n=15
In Ave.: 6.9/6.8/5.9
Out Ave.: 4.3/4.4/3.7
Ave Time In: 9.48
Ave. Change: 1.9/2.4/2.3

Table:4
Pt Name:Amy Crump
Wearing Schedule:Day
Degree of Myopia:Low
Starting Rx:-1.25
-1.50

Date	In	InAve	Out	Out Ave	Change	Total Time
5/17	245p	3/7	8p	1/2	2/5	5.25
5/25	815a	5/8	730a	1/1	4/7	11.25
5/27	815a	4/6	730p	1/1	3/5	11.25
5/29	830a	3/6	630p	1/1	2/5	10
6/15	830a	4/7	7p	1/1	3/6	10.5
6/19	915a	5/8	4p	1/1	4/7	6.75
6/21	1030a	5/9	915p	1/1	4/8	9.75
6/23	7a	1/5	830p	1/1	0/4	13.5
7/12	9a	4/8	845p	1/1	3/7	11.75
7/21	815a	3/6	7p	1/1	2/5	10.75
7/30	12p	4/6	5p	1/1	3/5	5
8/1	10a	3/5	630p	1/1	2/4	8.5
8/10	945a	4/7	9	1/1	3/6	11.25
8/19	8A	3/5	630P	1/1	2/4	10.5
8/23	830A	3/6	6P	1/1	2/5	9.5

n=15
In Ave.:3.3/6.6
Out Ave.:1/1.1
Ave Time In:9.7
Ave Change:2.6/5.5

Table:5
Pt Name:Joe De Pinto
Wearing Schedule:Night
Degree of Myopia:Low
Starting Rx:-1.75 -.50 x 012
-1.75 -.50 x 180

Date	In	InAve	Out	Out Ave	Change	Total Time
5/24	715p	6/6/5	3a	4/3/3	2/3/2	7.75
5/25	3p	6/5/4	1145p	3/3/2	3/2/2	8.75
6/9	2p	8/8/7	6p	4/3/2	3/4/4	4
6/22	430p	7/7/6	1030p	4/3/2	3/4/4	6
7/19	730a	8/7/6	4p	3/3/2	5/4/4	8.5
7/22	8p	8/7/6	12a	3/3/2	5/4/4	4
7/28	745p	8/7/6	4a	4/3/3	4/4/3	8.25
8/17	230p	8/7/6	1230a	4/3/2	4/4/4	10
8/26	120p	8/7/6	230a	4/3/3	4/4/3	13.17
9/1	1215p	6/4/4	430p	2/2/1	4/4/3	4.25
9/15	730a	7/7/6	5p	3/2/1	4/5/5	9.5
9/27	1115p	5/4/3	12p	4/3/2	1/1/1	12.75
10/20	1a	5/5/4	12p	2/3/2	3/2/2	11
11/12	1230a	6/7/5	1145a	2/1/1	4/6/4	11.25
12/15	1130a	6/6/5	12p	2/2/1	4/4/4	12.5

n=15
In Ave.:6.8/6.3/5.3
Out Ave.:3.2/2.7/1.9
Ave Time In:8.78
Ave Change:3.6/3.7/3.2

Table:6
Pt Name:Calvin Ebels
Wearing Schedule:Night
Degree of Myopia:Low
Starting Rx:-1.50 -.50 x 100
-1.00 -.50 x 055

Date	In	InAve	Out	Out Ave	Change	Total Time
5/18	7p	1/1	7a	1/1	0/0	12
5/21	6p	1/1	7a	1/1	0/0	13
5/23	9p	1/1	12p	1/1	0/0/	15
5/26	10p	1/1	1030a	1/1	0/0	12.5
5/31	1130p	1/1	9a	1/1	0/0	9.5
6/10	8p	1/1	7a	1/1	0/0	11
6/16	8p	1/1	7a	1/1	0/0	11
6/24	11p	1/1	9a	1/1	0/0	10
6/29	10p	1/1	10a	1/1	0/0	12
7/7	7p	1/1	7a	1/1	0/0	12
7/12	11p	1/1	9a	1/1	0/0	10
7/21	11p	1/1	10a	1/1	0/0	11
7/26	9p	1/1	10a	1/1	0/0	13
8/1	3a	1/1	11a	1/1	0/0	8
8/4	10p	1/1	12p	1/1	0/0	14

n=15
In Ave.:1/1
Out Ave.:1/1
Ave Time In:11.6
Ave Change:0/0

Table:7
Pt Name:Jeff Harvey
Wearing Schedule:Day
Degree of Myopia:Low
Starting Rx:-.75 -.25 x 160
-.50 -.50 x 020

Date	In	InAve	Out	Out Ave	Change	Total Time
5/19	11a	3/3	730p	1/1	2/2	8.5
5/25	730a	3/3	330p	1/1	2/2	8
5/31	730a	4/4	330p	1/1	3/3	8
6/10	730a	4/4	415p	1/1	3/3	8.75
6/22	730a	4/4	315p	1/1	3/3	7.75
7/7	715a	4/4	430p	1/1	3/3	9.25
7/20	730a	4/4	330p	1/1	3/3	8
7/23	730a	4/4	4p	1/1	3/3	8.5
8/3	715a	4/4	4p	1/1	3/3	8.75
8/11	730a	5/5	4p	1/1	4/4	8.5
9/8	730a	4/4/	4p	1/1	3/3	8.5
9/21	730a	4/4	3p	1/1	3/3	7.5
9/30	730a	4/4	230p	1/1	3/3	7
10/12	730a	4/4	3	1/1	3/3	7.5
11/10	730a	4/4	345p	1/1	3/3	7.75

n=15
In Ave.:3.9/3.9
Out Ave.:1/1
Ave Time In:8.1
Ave Change:2.9/2.9

Table:8
Pt Name:Julie McMullen
Wearing Schedule:Day
Degree of Myopia:Moderate
Starting Rx:-2.50 sph
-2.50 -.50 x 090

Date	In	InAve	Out	Out Ave	Change	Total Time
9/15	7a	8/8	11a	2/3	6/5	4
9/16	9a	7/10	1130a	5/4	2/6	2.5
9/17	645a	9/9	1130a	4/4	5/5	5.25
9/21	715a	7/9	9a	4/4	3/5	1.75
9/22	7a	8/9	10a	4/5	4/4	3
9/27	7a	10/9	9a	7/6	3/3	2
9/28	715a	9/9	10a	7/7	2/2	2.75
9/30	730a	10/9	10a	6/6	4/3	2.5
10/7	8a	7/8	10a	7/6	0/2	2
10/8	7a	8/8	10a	5/5	3/3	3
10/13	7a	9/9	10a	3/5	6/4	3
10/18	7a	9/9	11a	1/3	8/6	4
10/20	7a	6/7	12p	1/3	5/4	5
10/26	7a	11/11	12p	1/8	10/3	5
10/26	830a	7/8	10a	5/6	2/2	1.5

n=15
In Ave.:8.3/8.8
Out Ave.:4.1/5
Ave Time In:3.15
Ave Change:4.2/3.8

Table 9

Pt#	In Ave.	Out Ave	Ave. Wearing	Ave Change
1	9.7	5.6	7.7	4.1
2	2.4/2.6/1.9	1.7/1.3/1.1	10.3	.9/1.7/.8
3	6.9/6.8/5.9	4.3/4.4/3.7	9.48	1.9/2.4/2.3
4	3.3/6.6	1/1.1	9.7	2.6/5.5
5	6.8/6.3/5.3	3.2/2.7/1.9	8.78	3.6/3.7/3.2
6	1/1	1/1	11.6	0/0
7	3.9/3.9	1/1	8.1	2.9/2.9
8	8.3/8.8	4.1/5	3.15	4.2/3.8

Table 10a & 10b Day vs. Night Wear

Day Wear(Table 10a)

Pt#	In Ave.	Out Ave	Ave. Wearing	Ave Change
1	9.7	5.6	7.7	4.1
3	6.9/6.8/5.9	4.3/4.4/3.7	9.48	1.9/2.4/2.3
4	3.3/6.6	1/1.1	9.7	2.6/5.5
7	3.9/3.9	1/1	8.1	2.9/2.9
8	8.3/8.8	4.1/5	3.15	4.2/3.8

Night Wear(Table 10b)

Pt#	In Ave.	Out Ave	Ave. Wearing	Ave Change
2	2.4/2.6/1.9	1.7/1.3/1.1	10.3	.9/1.7/.8
5	6.8/6.3/5.3	3.2/2.7/1.9	8.78	3.6/3.7/3.2
6	1/1	1/1	11.6	0/0

Table 11a & 11b Low vs. Moderate Myopes

Low Myopes(Table 11a)

Pt#	In Ave.	Out Ave	Ave. Wearing	Ave Change
2	2.4/2.6/1.9	1.7/1.3/1.1	10.3	.9/1.7/.8
4	3.3/6.6	1/1.1	9.7	2.6/5.5
5	6.8/6.3/5.3	3.2/2.7/1.9	8.78	3.6/3.7/3.2
6	1/1	1/1	11.6	0/0
7	3.9/3.9	1/1	8.1	2.9/2.9

Moderate Myopes(Table 11b)

Pt#	In Ave.	Out Ave	Ave. Wearing	Ave Change
1	9.7	5.6	7.7	4.1
3	6.9/6.8/5.9	4.3/4.4/3.7	9.48	1.9/2.4/2.3
8	8.3/8.8	4.1/5	3.15	4.2/3.8