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Dioptic power differences in prescribing the Acuvue Advance silicone hydrogel lens

Abstract

Background: Based on anecdotal evidence it was thought that in fitting Acuvue Advance contact lenses, more plus power is needed than would be expected from the vertex corrected spectacle prescription.

Methods: We looked at 127 records of patients who had been fitted with the Acuvue Advance contact lens and compared their spherical equivalent spectacle correction with the power of lens dispensed to the patients.

Discussion: We found that final prescription powers tended to be within ± 0.50 Diopters of the spherical equivalent spectacle correction. Contrary to our hypothesis, we found that it was as equally likely for the contact lens prescription to deviate in the minus direction as in the plus.

Conclusion: From our results, it is apparent that our anecdotal evidence was faulty and there is not a statistically significant difference between the spectacle prescriptions and the final contact lens prescriptions of the patients in the study. Therefore, an over refraction is needed to pick the optimum lens for any contact lens candidate.

Degree Type

Thesis

Degree Name

Master of Science in Vision Science

Committee Chair

Peter Bergenske

Subject Categories

Optometry

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DIOPTRIC POWER DIFFERENCES IN PRESCRIBING
THE ACUVUE ADVANCE SILICONE HYDROGEL LENS

BY:
RICHARD H. HARRISON, NATHAN OWEN,
MICHAEL BEAN

A thesis submitted to the faculty of the College of Optometry
Pacific University Forest Grove, Oregon for the degree of Doctor
of Optometry May 2006.

Advisor: Peter Bergenske O.D.

Signatures

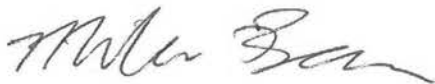
Richard H. Harrison

A handwritten signature in cursive script, appearing to read "Richard Harrison".

Nathan Owen

A handwritten signature in cursive script, appearing to read "Nathan Owen".

Michael Bean

A handwritten signature in cursive script, appearing to read "Michael Bean".

Peter Bergenske O.D. Advisor

A handwritten signature in cursive script, appearing to read "Peter Bergenske".

Grade Page

Biographies

Richard Harrison attended Rick's College in Rexburg, ID and was awarded an Associate's Degree in Arts and Sciences in January 1999. He later attended Western Oregon University in Monmouth, OR where he graduated Magna Cum Laude with a Bachelor of Science Degree in Psychology, with a Minor in Chemistry in August 2002. Following graduation from the Pacific University College of Optometry Rick intends to work in private practice in Austin, Texas.

Nathan Owen attended Brigham Young University in Provo, UT and graduated with a Bachelor's of Science Degree in Zoology in May 2001. He was a recipient of one the Air force Health Professions Scholarships in 2004. After graduation he will serve for three years with the Air Force and then plans to complete a residency in primary care optometry and ocular disease with the Veterans Administration in Utah.

Michael Bean attended Utah Valley State College and was awarded an associate's degree in Arts and Sciences in June 98. He then attended Brigham Young University where he received a Bachelor of Science Degree in Zoology in May of 2001. I plan on graduating from Pacific University College of Optometry in May 2006.

Acknowledgments

Abstract

Background: Based on anecdotal evidence it was thought that in fitting Acuvue Advance contact lenses, more plus power is needed than would be expected from the vertex corrected spectacle prescription.

Methods: We looked at 127 records of patients who had been fitted with the Acuvue Advance contact lens and compared their spherical equivalent spectacle correction with the power of lens dispensed to the patients.

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Conclusion: From our results, it is apparent that our anecdotal evidence was faulty and there is not a statistically significant difference between the spectacle prescriptions and the final contact lens prescriptions of the patients in the study. Therefore, an over refraction is needed to pick the optimum lens for any contact lens candidate.

Silicone hydrogel contact lenses are rapidly becoming a first choice lens for many practitioners. The design of the lens material allows oxygen to more rapidly diffuse across the lens surface, thus reducing overall ocular redness, dryness, and corneal neovascularization¹. These characteristics of silicone hydrogels afford the patient increases in wearing time as well as overall comfort¹. These lenses are allowing patients more flexible wearing schedules with a minimum of contact lens induced side effects, which is very appealing to the contact lens wearing population.

The Acuvue Advance, a silicone hydrogel lens relatively new to the market, is a widely used lens prescribed by practitioners due to its widespread availability, and the large marketing campaign initiated by Vistakon and Johnson and Johnson. The Acuvue Advance lens comes in a range of powers from -12.00 D to +8.00 D as a spherical lens design. It is available with a diameter of 14.0mm and two base curves, the 8.3mm and 8.7mm, with the 8.7 mm most commonly used. The Acuvue Advance has a Dk/t of 85 and is approved for daily wear use in the two-week lens category. A toric version of the Acuvue Advance lens was recently approved, but was not included in this study. The Acuvue Advance lens was based on similar design characteristics as that of the Acuvue 2, a lens which has been on the market for a number of years and has a proven sales record as well as broad clinical acceptance.

Historically, very little research has been performed to assess the agreement between a vertex corrected spherical equivalent spectacle correction and the accuracy of the expected contact lens power prescribed for the contact lens patient. According to the

fitting guide for Acuvue Advance distributed by Vistakon, the Acuvue Advance contact lens power should be the same as the spectacle prescription with vertex correction of any powers greater than +/- 4.00 D. There was no mention in this guide or in any literature that would suggest fitting the patient with more plus or less minus dioptic power with these lenses. Despite the fact that this lens shares a similar lens design as that of the Acuvue 2, no reports of discrepancy between vertex corrected spectacle power and contact lens power could be found in a literature search.

In discussion of this topic with other doctors experienced in the fitting and dispensing of the Acuvue Avance lens, there has been some belief that there may be a tendency for the patient to prefer more plus or less minus power than would be expected from the spherical equivalent vertex corrected spectacle correction. No information as to this assumption has been published up to this time, nor have other studies shown this tendency in other soft contact lenses, including the popular Acuvue 2 or the original Acuvue.

This research looks to verify or dispel this anecdotal evidence by looking at discrepancies between spectacle lens power versus vertex corrected contact lens power for the Acuvue Advance and finding if any tendencies can be found.

Factors affecting the on-eye power of contact lenses have been in the literature for some time, yet little information exists as to the specific properties of silicone hydrogels and on-eye power. A principle difference between conventional soft contact lenses and silicone hydrogels involves the differing materials that the two types of lenses are made of and the consequent differences in modulus of these materials⁶. Silicone hydrogels have shown to have as much as four to six times the modulus or stiffness as that of

conventional hydrogel material such as etafilcon A⁶. Interestingly, the Acuvue Advance is much less rigid than most of its other silicone hydrogel counterparts and carries a modulus just one and a half times greater than etafilcon A⁶. This is due to the decreased content of silicone found in the lens.

Modulus is important in on-eye power in that it may affect lens flexure on the eye and less ability for the lens to conform to the curvature of the cornea³. Silicone hydrogels are more apt to have this characteristic as they are more rigid and may thus cause slight power differences based on tear lens effects⁷. Research has demonstrated this tear lens effect to be variable and minor, but more often than not in the minus direction when looking at conventional hydrogels⁵. Furthermore, with this greater rigidity these lenses may also mask some degrees of astigmatism, though this has not been born out in clinical settings⁴.

Another factor affecting on-eye power of soft contact lenses is that of an increased temperature change and the resultant dehydration that occurs after a lens is placed on the eye⁵. This dehydration causes a reduction in lens thickness, total lens diameter, and front optic zone radius. Together, these changes result in a relatively minor overall shift in the minus direction. Research indicates higher water content lenses are more affected by hydration changes than low water content lenses, and thinner lenses being more affected than thick lenses⁵.

Methods

A retrospective study of records at the Pacific University Family Vision Center in Forest Grove, Oregon was performed. Spectacle prescriptions and contact lens

prescriptions from past records for patient's right eyes were obtained. A total of 127 records of patients who had been fit and dispensed with the Acuvue Advance contact lens were acquired. The spectacle prescriptions ranged from -8.00 D to $+2.62$ D with an average of -3.06 D.

The spectacle prescriptions obtained from the records were converted to their spherical equivalents if the record was shown to have a cylindrical component in the spectacle prescription. This was done to recreate as best as possible the thought process that a practitioner would reasonably take for selecting the best lens for a particular patient. Spectacle lens prescriptions were then corrected to the plane of the cornea based on an assumed vertex distance value of 12 mm for each spectacle prescription more hyperopic or myopic than ± 4.00 diopters. These calculations enabled direct comparison of dioptric power between spectacle prescriptions and that of the prescribed contact lens power. The differences between the contact lens prescribed and the corrected spectacle prescription were calculated as well as the mean of the two powers. The results were then plotted on the graph below to show the dioptric difference between the spectacle and contact lens prescriptions. This was done to assess the limits of agreement for these two parameters (fig. 1). We further assessed the limits of agreement for lower myopic prescriptions and higher prescriptions using -4.00 D as the cutoff point (fig .2 and fig. 3).

Results

The mean difference between the vertex corrected spectacle prescription and the contact lens powers prescribed was calculated out to plus or minus -0.02 D. The standard deviation was found to be 0.26 Diopters. These results exhibit strong agreement between

a patient's spectacle prescription and the potential contact lens prescription when prescribing the spherical Acuvue Advance contact lens. There was also a tendency for a greater difference in the contact lenses prescribed as the power of the patient's spectacle prescription increased in the minus direction. When looking only at prescriptions of less than -4.00 D we find that the final contact lenses prescribed were very close to the spectacle correction with a mean difference of 0.008 D with a standard deviation of 0.18 D. The results were slightly different when prescriptions of greater than (-4.00) were placed on the eye. There was a mean difference of -0.09 D with a standard deviation of 0.29 D. The following table summarizes the findings of the study.

Mean Spectacle RX (n=110)	-3.06 D
Mean CL RX (n=110)	-3.03 D
Mean Difference	- 0.02 D
Std Dev. Of Difference	+/- 0.26 D
Limits of Agreement Overall	-0.02D+/-0.52D
Mean Difference Spec RX (<-4.00 D)	0.00 D
Std. Dev of Difference (<-4.00 D)	0.18 D
Limits of Agreement (<-4.00 D)	0.00+/- 0.36 D
Mean Difference Spec RX (>-4.00 D)	-0.09 D
Std. Dev. Of Difference	0.29 D
Limits of Agreement (>-4.00 D)	-0.09 D +/- 0.58 D

Discussion

This study attempted to answer the question whether or not a statistical difference between mean vertex corrected spectacle power and mean prescribed contact lens power for the Acuvue Advance lens exists. Based on empirical clinical findings it was thought that the contact lens prescription prescribed would show a statistical difference in the plus direction. While results of this study failed to show a statistically significant relationship, a clinical prospective study with data collected in a more controlled fashion could be performed to show a more definitive answer. Furthermore, as this was a retrospective study based on records obtained from a large clinic with many practitioners (mostly optometric interns) spectacle and contact lens prescribing philosophies and techniques likely differed between practitioners. An autorefraction assessment which limits inter-practitioner variability in prescribing lens powers for patients should be used on any subsequent research on this subject.

The variability of the difference in contact lens versus spectacle correction especially at higher powers is one question that deserves further study. Several factors may be at play that could explain the poor reliability of selecting an initial contact lens power after vertex correction. One possibility is the fitting relationship of a contact lens and the distribution of powers across the lens that determines the ultimate power of the lens. Higher powers of contact lenses fitting slightly high or low could induce differences in power that could presumably affect the effective final on-eye power.

In addition, it has been shown that lens flexure on the eye can induce differences in dioptric power necessary to correct a patient's refractive error⁷. A silicone hydrogel lens with a stiffer or more rigid lens material as in the Acuvue Advance lens flexes more on the eye resulting in a tear lens effect under the lens. Contact lenses correcting for

moderate to high myopia have been shown to flex more on the eye thus inducing a shifts in total on-eye power. Lenses of low minus correction or plus correction have been shown to induce a shift towards more minus power². This phenomenon could help to explain the reason for the variability between individuals in the data collected especially at higher powers.

Mislabeled lenses or poorly manufactured lenses might also cause a difference in the expected final contact lens power prescribed.

Overall, results of the study exhibited strong agreement between vertex corrected spectacle prescription and the actual contact lens prescription. A plot of the mean difference between the vertex corrected spectacle prescription and the contact lens prescription, however, showed that variation exists in both the plus and minus direction with a slight, albeit not statistically significant predilection for the plus direction. It is important to note here that though a dioptric power difference may show statistical significance it may not necessarily be the case clinically. Vice versa, depending on the number of patients enrolled in a given study, a clinical significance may show up with as little as 0.25 Diopters of difference whereas statistically this may not be sufficiently large to show significance. Thus, while no statistical significance was found when the two groups were compared, dioptric power differences for any individual patient must be noted; those 0.25 diopters of difference or larger demonstrate clinical significance for a given patient.

One important conclusion that was drawn from the study involved the question whether or not one could predict which patients might show a difference between their spectacle prescription and the vertex corrected contact lens prescription. The results

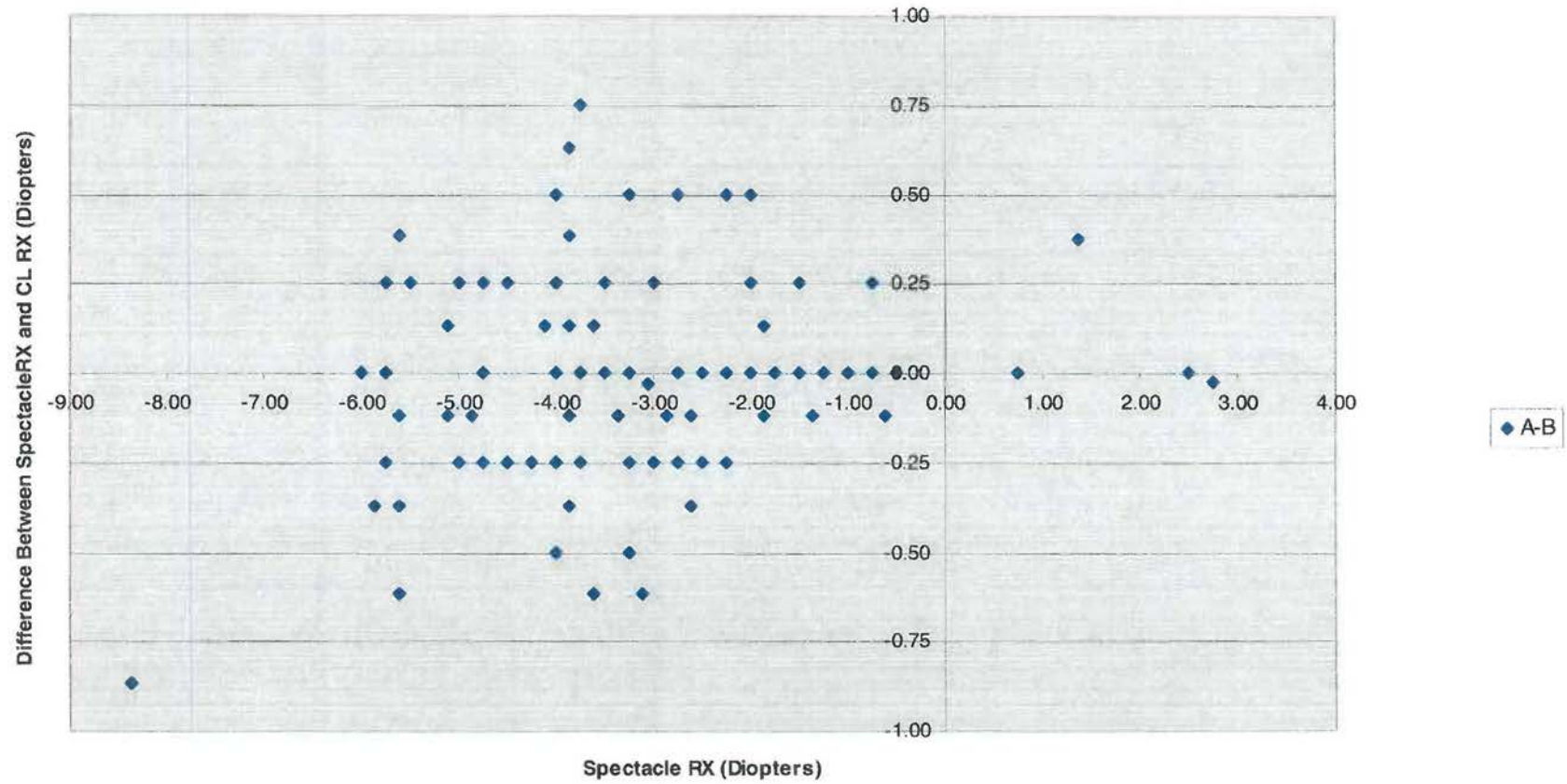
indicate that there is no means of predicting which patients will show a difference in the spectacle versus contact lens prescription. Moreover, the direction of the difference whether plus or minus could not be predicted either. Interestingly, as was noted previously, patients requiring higher contact lens powers are more likely to exhibit greater differences between spectacle prescriptions versus vertex corrected contact lens powers.

Based on this information it is recommended that when fitting the Acuvue Advance lens an over refraction be performed to select the most appropriate contact lens for the patient. This will ensure that a patient is neither over nor under corrected while wearing the contact lens. As always, a visual acuity assessment should be performed to reveal any loss in acuity while wearing the lenses. Any decrease in acuity should be investigated to determine if the patient needs a change in power of the lens or if the Acuvue Advance lens is not suitable for the patient.

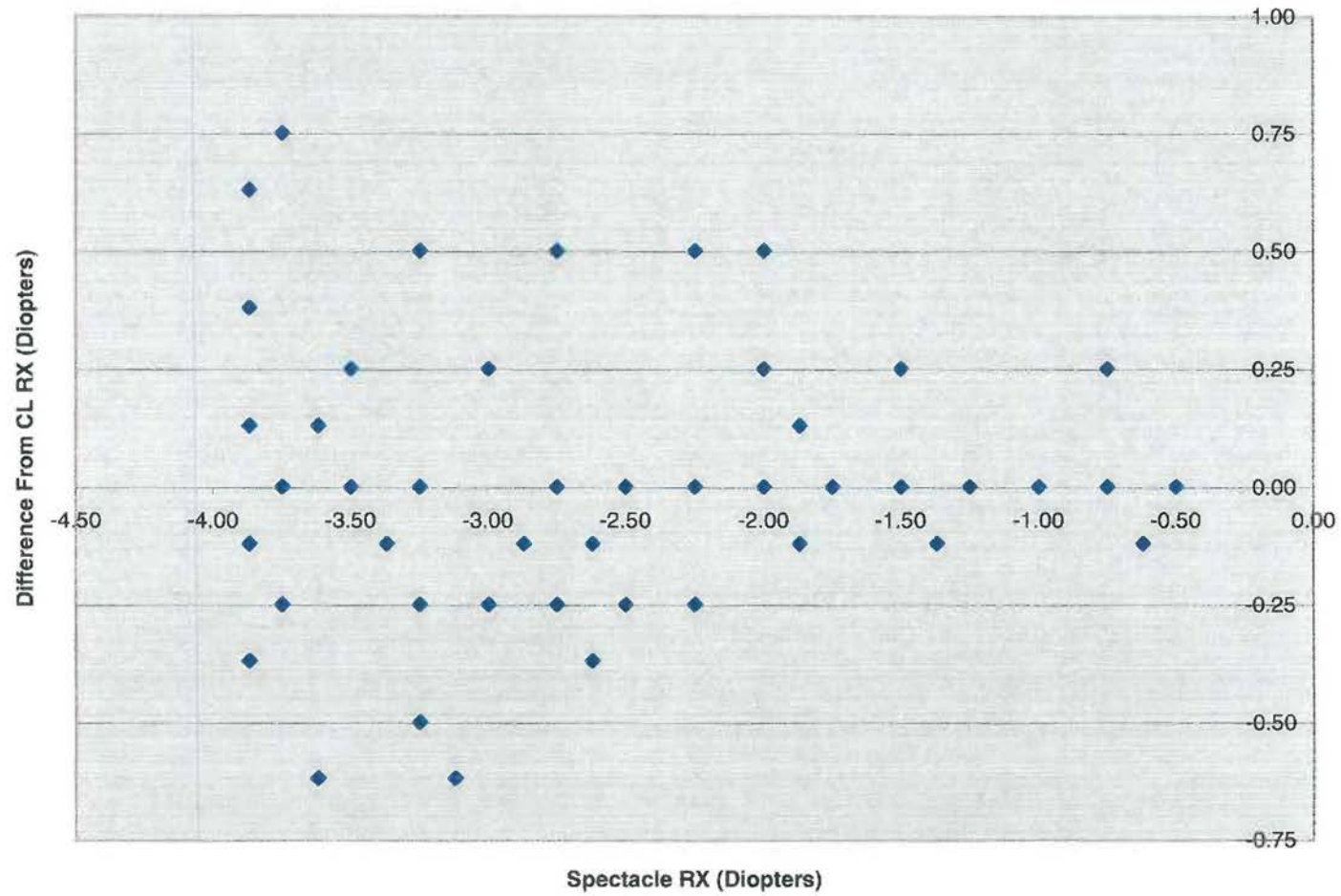
This study demonstrated that when fitting the Acuvue Advance lens in particular, vertexing the spectacle prescription to the corneal plane alone proved unreliable to select the most correct power for the patient. This has implications for other silicone hydrogel lenses as well. No reports of similar problems with initial contact lens power selection could be found with other silicone hydrogels. However, based on the similar lens material that silicone hydrogels employ and the consequent higher modulus of the lens material it is reasonable to suspect other lenses of this type might show the same trend towards unreliability in power selection especially in lenses of higher powers. Further study should be performed using a variety of silicone hydrogels as well as conventional soft contact lenses in a controlled fashion to determine the reliability of lens power

selection when vertexing to the corneal plane. Special interest should be given to silicone hydrogels of higher modulus as well as those convention hydrogels based on an aspheric design.

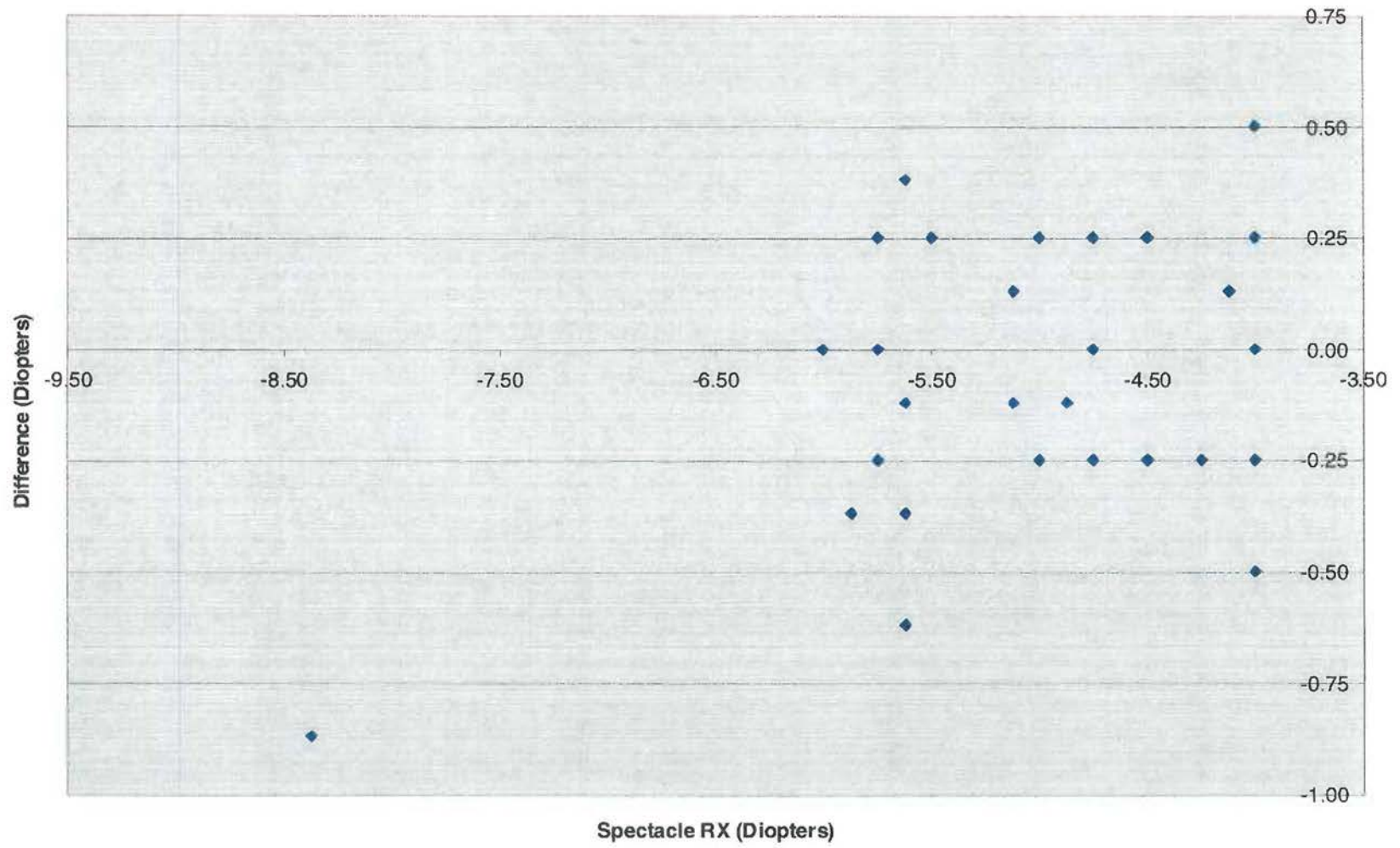
Difference Between Spectacle RX and Contact Lens RX Given (All)



Difference Between Spectacle RX and Contact Lens RX (<-4.00 D)



Difference Between Spectacle RX and Contact Lens RX (>-4.00 D)



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