The Correction of Static and Dynamic Aniseikonia with Spectacles and Contact lenses

A Clinical Communication

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Aniseikonia is comprised of both a static and a dynamic component[1]. The most common cause of both these forms of aniseikonia is anisometropia and its spectacle correction [1-3]. Static aniseikonia and its associated asthenopia results from unequally sized retinal images[1-3]. Estimates of differing magnifications can be made from optical parameters (relative spectacle magnification) of the eye and the shape and power factors of the ophthalmic appliance [2,3]. Contact lenses reduce the influence of both shape and power factors due to their minimal thickness and vertex distance.. General optical analysis has led to differing approaches to corrections when the primary cause of the anisometropia is refractive differing optical powers compared to axial (differing axial lengths)[2,3]. Simple optical analyses (Knapp's Law) suggest the former form is best corrected with contact lenses while spectacles are best suited for the latter[4]. However, empirical investigations dispute the predictions of Knapp's Law [5] in axial anisometropia suggesting contact lenses are effective in both cases.

Inter ocular magnification differences can be reduced through adjustment of both shape and power factors of spectacle lenses.. However, such adjustments must be done keeping the cosmetic outcome in mind. While the reduction of asthenopic symptoms is a good measure of success, actual measures of the magnification differences perceived by the patient provide important confirmation. Eikonometers [1,2,6] have been designed allowing static aniseikonia to be measured and corrected by the use of size lenses placed before one eye. Aniseikonia is measured either through size comparisons or binocularly through the detection of unequal degrees of retinal disparity across a range of eccentric viewing positions.

Dynamic aniseikonia results from anisometropia when viewing is eccentric from the optical centres of the correcting spectacle lenses. The effect can be computed from Prentice's Law ($\Delta = cF$) where lens power (F) in this case is the net difference between the two lenses. (Figure 1).

Anisophoria results where phorias measured through both lenses at specific eccentricities vary

due to the prismatic effects. [1,2] The dynamic component can be measured with a Maddox rod

where the anisophoria is nulled with a size lens as opposed to varying degrees of prism. Contact

lenses of course allow the dynamic component to be minimized as the optical correction moves
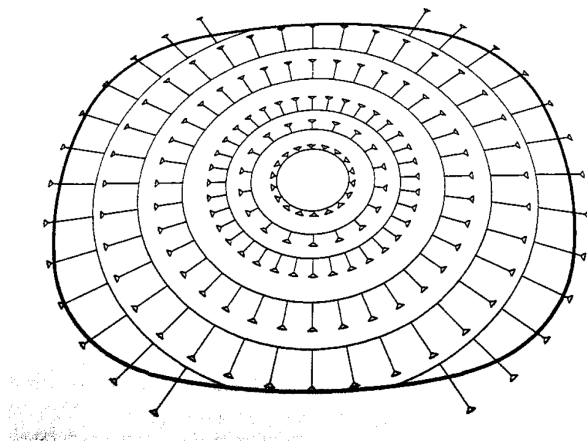
with the eyes.

Figure 1. A schematic of the induced prismatic effect for a concave lens in accordance
with Prentice's Law. The effect (prism base and magnitude) is dependent upon the eccentric gaze
position. In anisometropic myopia, dynamic aniseikonia results in a similar prismatic pattern
induced in this case, by differing net optical powers between the two lenses. (Reproduced with
permission from Remole A, Robertson KM. Aniseikonia and anisophoria, Current concepts and
clinical applications. Waterloo, Ontario: Runestone Publishing; 1996p. 134)

We describe a case of where significant anisometropic astigmatism was accompanied with

considerable asthenopic symptoms. . Symptoms were not alleviated by the prescribing of a

partial spectacle correction. Subsequent treatment with a contact lens and an iseikonic spectacle

correction did alleviated the asthenopia   We confirmed that this symptomatic relief was linked

to the reduction of the static and dynamic components of aniseikonia achieved with her contact

lens and iseikonic spectacle lenses compared to a standard spectacle lens design.

Case Report

The patient, a 24 year old female with anisometropia, (Rx currently RE+1.00/-0.25 x 095; LE+5.75/-3.50x075) had her first eye examination at 15 years of age with a long-standing history of poor vision in the left eye. The treatment proposed at that time was a partial correction of the anisometropia in spectacles that corrected roughly half the spherical and cylindrical components of the anisometropia. After a month, the initial symptoms of headache and nausea were still significant and the patient was not successful at wearing the spectacles for more than 30 minutes or so at a time. The spectacles were abandoned 1 year later on the advice of a different practitioner who did not suggest any further refractive correction. At 22 years of age, she saw a different optometrist who fitted her left eye with a contact lens(Intelliwave Toric), Initial best-corrected acuity was 6/7.5 but after a period of adaptation an acuity level of 6/6+ was achieved. At 24 years of age, she requested a spectacle Rx in order to reduce her wearing time for the contact lenses. A full anisometropic and iseikonic spectacle Rx correction was ordered from Shaw Lens Co.

  Ocular heath parameters were within normal limits, with only trace staining due to dryness in both eyes, IOPs of 12 mmHg in each eye, no significant media opacity, cup/disc ratio of the optic nerves of .25 in each eye and no retinal lesions.

Correction	Rx RE	Rx LE	n	RE h mm	LE h mm	RE ct mm	LE ct mm	RE, bc (D)	LE, bc (D)
Standard Spectacle Rx	+1.00/-0.25 x 095	+5.75/-3.50x075	1.49	11	12	2.7	4	+5.75	+5.25

Iseikonic Spectacle Rx	+1.00/-0.25 x 095	+5.75/-3.50x075	1.6	7.8	6.9	6.2	3.4	+9.00	+6.00
Contact Lens	Plano (no lens)	+5.75/ -3.25 x 070 Intelliwave Toric,,Efrofilcon A material			14.5diam	8.6			

Table1. Details of the Optical Corrections. h= vertex distance, ct = centre thickness, bc = base curve

The patient then consented to have the details of her ophthalmic corrections confirmed and to undergo empirical measures of static and dynamic aniseikonia through her current contact lenses and iseikonic Rx. The unsuccessful partial Rx had been abandoned and presumably would not have provided equal vision in each eye. In order to identify the aniseikonia her current Rx was fabricated using standard base curves and lens thicknesses and placed in an appropriate frame. Static aniseikonia was measured with a Remole eikonometer[2] (Fig.2) in three conditions: with contact lenses, with the full prescription in standard spectacles, and with the iseikonic spectacles. This eikonometer quantifies static aniseikonia binocularly from the tilt of the fronto -parallel plane (FPP). Due to the axis of the cylinder in the LE, the 5 vertical pins measuring the FPP were set at 45 degrees. Size lenses were used to null the tilting of the FPP.
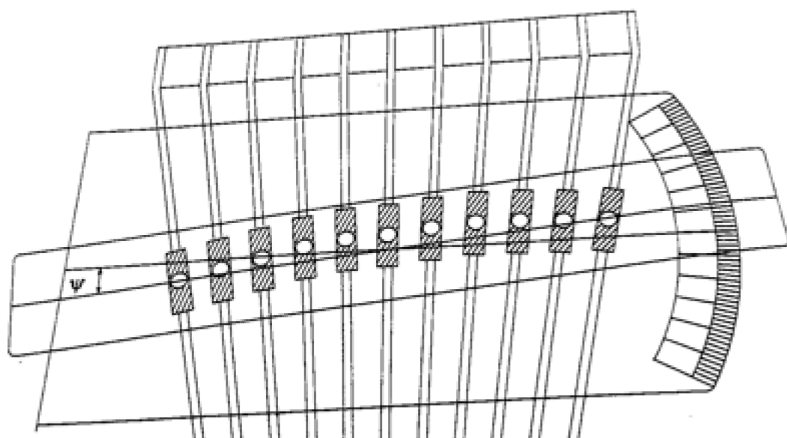
Figure 2: The Remole Eikonometer measures static aniseikonia by subjective binocular settings of the FPP using 11 rods. Magnification differences between the eyes results in an angular tilting (Ψ) of the FPP towards the eye with the higher magnification. The eikonometer can be rotated (not shown) to allow FPP to be measured in the vertical, horizontal and two oblique meridians (45 and 135 degrees) (Reproduced with permission from Remole A, Robertson KM. <u>Aniseikonia and anisophoria, Current concepts and clinical applications.</u> Waterloo, Ontario: Runestone Publishing; 1996 p. 264)

A Maddox rod was used to measure the dynamic component of the aniseikonia using the same three lens conditions as the static measurements. The dynamic measurements were done in primary gaze and then 5.71 degrees above and below the primary line of sight. A small vertical phoria was present in primary gaze in all conditions. For the conditions where the phoria was not the same as in primary gaze, size lenses were used to induce a phoria measure equal to that found in primary gaze. In order to compensate for small discrepancies between the line of sight and the optical centres of the lenses results for upward and downward gaze were averaged and the mean 3 measures show below in Fig.3.

Keratometry was conducted using a Pentacam scan (Oculus, Inc., U.S.A.) which found RE: 42.8 @ 136.5, 43.1D @ 46.5, OS: 41.5 @ 065, 44.3 @ 155 Average K's: 42.95D RE and 42.9 OS.

A -scan ultra sound measures (average of three readings) were taken in accordance with manufacturer's guidelines(CineScan S, Quantel Medical, Bozeman, U.S.A). A difference in axial lengths between the two eyes was found RE 24.4mm; LE 21.9mm. (Note one extremely high reading was retaken from the RE in order to keep the SD within 0.1mm and consistent with previous studies[5].

Results

The keratometry values accounted for 2.8 D of the 3.5 D of ocular astigmatism, but since the average K's were approximately 0.5 D apart, the keratometry readings alone did not account for the average anisometropia of 2.44 D. An axial component was confirmed with the ultrasound measures. Therefore, the spherical anisometropia has a considerable axial component but the cylinder is mostly corneal. Th results of the dynamic aniseikonia measures (anisophoria) measures are shown in Figure 3.

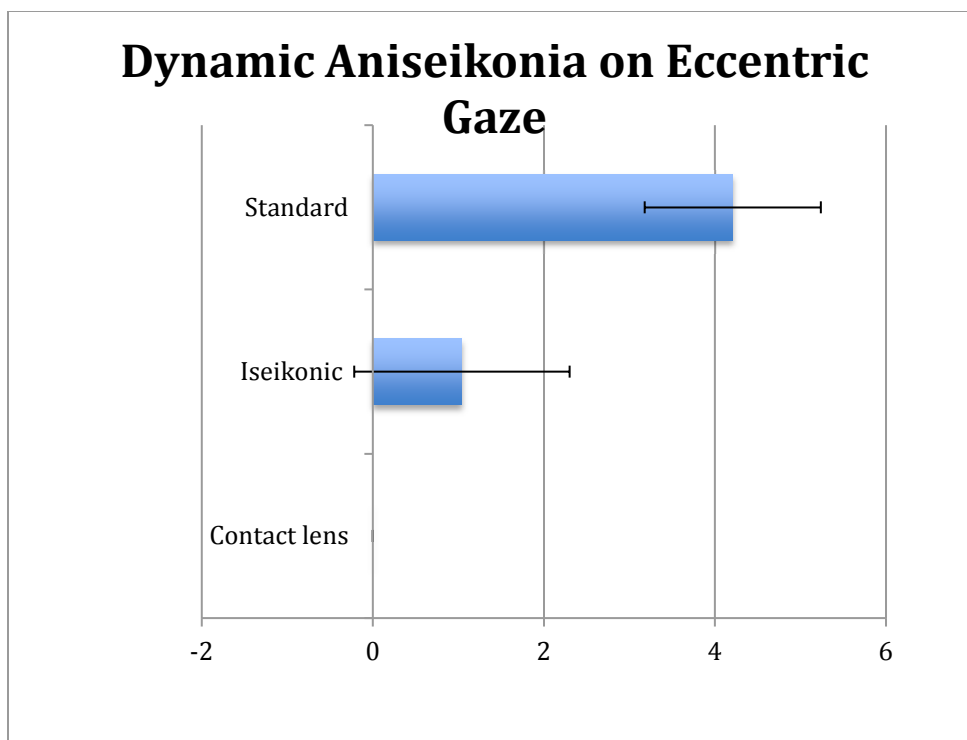## Dynamic Aniseikonia on Eccentric Gaze

Figure 3: With contact lenses, the vertical phoria did not change in the different positions of gaze. With the iseikonic lenses, an average dynamic component of 1.04% was found. The largest dynamic measure was 4.21% found with the standard spectacle design.

The Remole eikonometer found the difference in static aniseikonia (relative magnification) to be at 5% for the standard spectacle lenses but less than 1% for both the Shaw (iseikonic) lenses and the contact Lenses.

The Convergence Insufficiency Symptom Survey[7] was used to define the degree of asthenopia for all three corrections where higher scores reflect greater asthenopic symptoms. A score of 8 was reported for both contact lens and iseikonic lenses, but a score of 15 was given with the standard lens wear. These subjective symptom scores varied directly with the degree of aniseikonia present.

Discussion

While we did not test the initial partial correction prescribed for the patient, standard spectacle lenses resulted in both static and dynamic aniseikonia. Symptoms were significant and ameliorated with iseikonic lenses and contact lenses both of which significantly reduced both static and dynamic components of aniseikonia. The case history suggests that under correcting the anisometropia did not alleviate the symptoms. In this particular case, the contact lenses as predicted were the most effective at controlling the dynamic component of the aniseikonia. The iseikonic lenses were also effective in reducing the dynamic component in downgaze, which is of importance for reading and other near tasks. Static aniseikonia was reduced equally by both appliances.

Given the significant axial component ,the successful outcome using contact lenses would not have been predicted by Knapp's law. Possibly, this can be explained by the significant dynamic aniseikonia component found with the standard lens. . For anisometropic patients showing symptomatic aniseikonia, treatment plans should consider both contact lenses and iseikonic spectacle lenses. Under correction of the anisometropia using standard lenses would not appear to be a viable solution.

Acknowledgements

eikonometer designs of the late Professor Arnuf Remole are greatly appreciated and remembered. This research was funded by NSERC Canada and the Canadian Optometric Education Trust Fund.

Disclosure

Professor William Bobier is a member of the Technical Advisory Board of Shaw Lens Co. The role is strictly advisory and he has not received any funds from Shaw Lens Co. Further, he was not involved in the clinical decision to use Shaw Lens as a provider of the iseikonic spectacle lenses.

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