Original Article

Comparison of three different techniques of binocular balancing.

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ABSTRACT:

OBJECTIVE: To compare three different binocular balancing techniques, and to evaluate their results to find that how much the results of these three techniques correlate with each other.

METHOD: Screening of Visual acuity with and without pinhole, objective and subjective refraction, plus one blur test, fogging method, Humphrey's immediate contrast, vertical prism test were carried on sample size of 100 patients having best corrected VA 6/6 or 6/9using Snellen chart. Screening tests were performed to find gross data. Data is quantified by the SPSS 20.

RESULTS: Highest correlation is present between the mean values of Humphrey's immediate contrast and vertical prism dissociation.The mean difference is lower between fogging method and Humphrey's immediate contrast.

CONCLUSION: As the data suggest, Fogging method, Humphrey's immediate contrast and vertical prism dissociation test yield very similar results. The findings of these three techniques can be considered interchangeable.

INTRODUCTION:

Myopia, hypermetropia and astigmatism are the types of refractive errors. If these refractive errors remain uncorrected, it can lead to impairment of vision and disturb the quality of life. These errors are not specific for any age group, sex and races. They are easily diagnosed, managed and corrected with spectacles or contact lenses to achieve normal vision. If the correction is poor or inadequate, these errors, sometimes, become a cause of low vision and may even lead to blindness.[1]

Myopia or nearsightedness is a visual condition in which near objects are seen more clearly but far objects appear blurred and far point come close to the near point. Cause of myopia is increased axial length or increased curvature of the cornea. As a result light entering the eye is not focused correctly and distant objects look blurred.
Hypermetropia is a visual condition in which distant objects are seen clearly but close ones do not come into adequate focus point. It is caused by short axial length of eyeball or cornea little curvature, so light entering the eye is not focused correctly.

Astigmatism is a condition that coexists with spherical errors and it is correctable like myopia and hyperopia, with spectacles and contact lenses.[2]

The prevalence rate of myopia, hypermetropia and astigmatism is different for different countries according to previous researches. In Pakistan the prevalence of myopia is 36.5%, hypermetropia 27.1% and astigmatism is 37% of all refractive errors. This Pakistani survey provides the first authentic national estimates.[3] For comparison, In Singapore prevalence rate of myopia in medical university students was 89.8%, hypermetropia 1.3% and astigmatism was 82.2%.[4]
Emmetropization is a process that regulates the eye growth by using visual stimuli in a way that usually eliminates the refractive errors. The mechanisms that control the emmetropization remain active into childhood and play an important role in maintaining the good refractive status and balance of refraction between the two eyes. It is also probably that visual experiment that occur through these mechanics participate in the development of many refractive errors.[5]

Refraction is of two types, subjective refraction and objective refraction. Automated refractrometer objectively measure aberrations of the eye and it is widely used in optics, ophthalmology and optometry. While subjective refraction can be variable, its accuracy remains suspect due to some reasons.[6] Subjective refraction subjectively determines the refractive error by means of spherical and cylindrical lenses which are essential to provide best visual acuity with accommodation at rest. Principle of refraction is to keep the accommodation at rest by giving the maximum plus and minimum minus lenses. Always use trial frame before prescribing the glasses. Take into account vertex distance especially for high prescription individuals. To ensure accommodation is at rest position use plus lenses to fog and be sure image is in front of retina.

Cycloplegic refraction is also a type of refraction which is more sensitive than the subjective refraction and used especially in children and young adults to measure the refractive error in hypermetropic and pediatric cases.[7]

Refractive error is the combination of eye, its anatomical component and light that focus either in front or behind the retina or focus on the retina when accommodation is maximally at rest. When light falls directly on the retina this condition is normal and said to be emmetropic. Refraction changes with age and amplitude of accommodation decreases progressively with increasing age. Amplitude of accommodation can be accelerated by moving an object close to eyes or by placing minus lenses in front of the eyes.[8]

There are number of refraction steps; first step is taking visual acuity, then objective and subjective refraction, then post refraction test, Duochrome test, Jackson cross cylinder, and at the end of subjective refraction binocular balancing is done.

The end point of subjective refraction is to equalize or balance monocularly the subjective endpoints for the both eyes. This is done with laying claim that each eye is fully corrected with maximum visual acuity at distance. The techniques which are applied to equalize the accommodative status of two eyes are known as binocular balance or spherical equalization of two eyes.[9]

When monocular refraction is done, the practitioner checks one eye at a time but mostly patients use both of their eyes to attain clear and more comfortable vision and to achieve Binocular Single Vision (BSV). Occlusion can initiate accommodation in the eye which is not tested.
According to Herring's rule,

> "An increase in accommodation in the eye being tested, will result an equal increase in accommodation in fellow eye"

As in binocular spherical refraction maximum plus is obtained at the end, this result is not obtained by the monocular subjective refraction. This can lead to over plusing and over minusing of the endpoint especially with hypermetropic and myopic patients. Equalization of accommodation status is obtained by equalization of the visual acuity but it is not necessary that binocular balancing produce equal visual acuity in each eye at the end. Because some patients have good vision in one eye as compared to the other and by balancing both eyes, equality may disturb the vision and may be uncomfortable for the patient.[10]

The binocular balance test is done after monocular

subjective refraction to ensure that accommodation is balanced in the two eyes. There is no need to perform this test if the patient is monocular, or if they have no accommodation. There are several techniques that have been described such as fogging method, Humphrey's immediate contrast, prism dissociation test, and, red and green dissociated method.

Last step in the subjective refraction is to equalize the accommodation. Previous researches have favored binocular stimulation with Turville infinity balance but there is no significant difference between the balancing techniques; mean value also shows similarity.[11]

When the accommodation ability is reduced then there is no need to balance the accommodation, such as in presbyopic and pseudophakic patients. It is also considered that when subjective refraction is done there is no need to do separate binocular balancing when we have to maintain the peripheral fusion because this binocularity helps to control the accomodation.[12]

Different types of techniques have been developed to equalize the accommodative status in eye.

The more common techniques for balancing are:

1.   Alternate occlusion method
2.   Prism dissociated blur test
3.   Prism dissociated duochrome technique
4.   Humphrey's immediate contrast (HIC)[13]

West and Somer introduced several methods of binocular balancing to equalize the accommodation between the two eyes. They compared five techniques of balancing by which equal vision was achieved by plus one blur test, red green duochrome equalization, Jackson cross cylinder and reported that these techniques have almost equal results only with a small differences in the results.[11]

According to a research of 2007 in prism dissociation blur test both eyes were fogged with +1.00D. by adding this vision is reduced one line above the best corrected visual acuity, then equal power of prisms were added of 3 diopters with base up in one eye and base down in other eye to dissociate both eyes. Then comparing the results of two eyes, +0.25 D was added in front of that eye which had clear vision until the both eyes had equal vision. Then fogging is removed step by step until final best acuity is achieved with maximum plus lens.[14]

To apply the Humphrey's immediate contrast method, left eye was fogged with +1.00D and instructed the patient to see the line which is best to see with right eye. Then +0.25 is added in front of right eye, if the acuity improves then added +0.25 in steps until stop to improve. The goal of this method was to achieved maximum plus power and minimum minus power. Same procedure was done with the left eye.[15]

RESULTS:

Table 1: Correlation between the fogging method and Humphrey's immediate contrast

	Right fogging	Right Humphrey's immediate contrast	Left fogging	Left Humphrey's immediate contrast
Pearson correlation	1	0.992	0.912	0.912
Significant (two tailed)	100	0	0	0
N		100	100	100

This chart shows that there is a strong correlation between fogging method and Humphrey's immediate contrast. These two techniques can be interchangeable.

Table 2: Correlation between fogging method and vertical prism dissociation

	Right fogging	Right vertical prism dissociation	Left fogging	Left vertical prism dissociation
Pearson correlation	1	0.992	0.912	0.913
Significant (two tailed)	100	0	0	0
N		100	100	100

This chart shows that fogging method and vertical prism dissociation correlates with each other and can be interchangeable.

Table 3: Correlation between Humphrey's immediate contrast and vertical prism dissociation

	Right Humphrey's immediate contrast	Right vertical prism dissociation	Left Humphrey's immediate contrast	Left vertical prism dissociation
Pearson correlation	0.992	0.992	0.912	0.913
Significant two tailed	0	0	0	0
N	100	100	100	100

DISCUSSION:

Binocular balancing techniques have advantages as well as disadvantages. Alternate occlusion method has restrictions because two eyes cannot see at a time and both

eyes have unequal vision and only uncovered eye accommodate at a time.[16]

The purpose of the balancing techniques is to provide coinciding representation of similar form to both eyes. For this purpose we block out one or other eye from any stimulus by polarization, prismatic doubling, and alternate occlusion or by the combination of these methods.[17]

According to a research prism dissociated and Humphrey's immediate contrast showed 95% of the correspondence and can be exchanged because their values are almost same.[18]

It was concluded by Smith et al that all techniques had almost same results and matched with the subjective refraction; however, some significant differences might be present in different people.[19]

A research was conducted in 2014 in which two balancing techniques, Turville infinity balance and Humphrey's immediate contrast, were compared to balance the accommodation. This research showed that Turville infinity method is better than Humphrey's immediate contrast.[20]

Another research conducted in 2014 showed that there is very little difference between alternate occlusion methods with the prim dissociated method. Highest correlation is present between the red and green dissociation and Humphrey's immediate contrast method.[21]

CONCLUSION:

Both methods have strong correlation and can be used interchangeably.

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