International Journal of Medical Ophthalmology

E-ISSN: 2663-8274
P-ISSN: 2663-8266
www.ophthalmoljournal.com
IJMO 2022; 4(1): 96-100
Received: 04-01-2022
Accepted: 24-01-2022

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Comparing color vision impairment in natural lens and artificial lens groups

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DOI: https://doi.org/10.33545/26638266.2022.v4.i1b.181

Abstract
Objective: To determine the color vision defect in pseudophakic and phakic group.
Material and Method: This was cross sectional with non-probability convenient sampling at Fathima institute of medical science, Ophthalmology Department, Kadapa. The patient's age lied between 45 to 60 years and had a follow up after 1 month of surgery. Visual acuity taken was after refraction. All types of refractive errors after Phacoemulsification surgery (Acrylic IOL) were included. Posterior sub-capsular opacity and other types of cataract surgery were excluded. The Panel D - 15 test was used to assess color vision defect. Ethical approval was given by Research Ethical Committee. Statistical analysis was done by statistical package for social science (SPSS) version 20.0.
Results: A total of 160 eyes were enrolled in this study. Among 160 eyes; 70 (44%) and 90 (56%) eyes were of males and females, respectively. The eyes were categorized in two groups, 80 (50%) were phakic and 80 (50%) were pseudophakic. Among 80 (50%) pseudophakic eyes; 32 eyes had Tritanopia (40%), 10 eyes had Deutronopia (13%), 8 eyes had Protonopia (10%), 6 eyes had combined Tritonopia and Protonopia (8%), 4 eyes had combined Deutronopia and Tritonopia (5%), 2 eyes had Protonopia and Deutronopia (3%) and 18 (23%) had no defect. Among 80 phakic eyes, 72 (90%) had no defect while Deutronopia was found in 1(1.25%) eye and Tritanopia in 7 (9%) eyes.
Conclusion: Tritonopia was mostly present in Pseudophakic group while majority of Phakic group do not show color vision defect.

Keywords: Pseudophakic, phakic, panel d-15, acrylic (IOL), color vision defect (CVD)

Introduction
Color vision deficiencies diminish the capacity to separate certain colors under specific circumstances and its testing identify the existence, type, and severity of defects, providing a basis for the evaluation of the defect's impact on personal and professional performance [1]. Color vision discrimination deteriorate with progressing age [2]. Ocular diseases such as cataract and glaucoma [3], trauma and certain medication also affect color vision [4]. Chromatic discrimination is assessed by color vision testing [5] by using different color vision tests. [6, 7, 8, 9] In European Caucasians the prevalence of color vision deficiency is about 8% in men and about 0.4% in women and between 4% & 6.5% in men of Chinese and Japanese ethnicity, respectively [10]. Some regional prevalence studies showed diversity in prevalence such as Turkey (7.3%), Iran (4.7%), India (2.8% to 8.2%, ethnic variations) and Saudi Arabia (2.9%) [11]. While in Pakistan color vision deficiency (CVD) ranges from 0.9% [12], 2.48% [13] and 2.78% [14].

Methodology
This cross-sectional study with non-probability convenient sampling was carried out in the Male and Female OPD at Fathima institute of medical science, Ophthalmology Department, Kadapa. The protocol for examination for all patients who met our inclusion exclusion criteria were included. Visual acuity was recorded separately both for near and distance, with and without glasses and with pinhole. A total of 160 eyes were taken with 80 eyes pseudophakic and 80 eyes phakic. Inclusion criteria included age ranged from 45 years to 60 years old, Phacoemulsification surgery with Acrylic IOL implant, follow-up after one month & all types of refractive errors after cataract extraction and visual acuity ranges from 6/18 to 6/6. Posterior sub capsular opacity and other types of cataract surgeries and systemic diseases were excluded. The Panel D15 test was performed at 33cm distance to find the changes in color vision. Self-prepared Performa was used for collection of data. Statistical analysis was done on statistical package for social science (SPSS) version 20.0. All the categorical variables were presented as frequencies and percentages.

Results

The eyes were categorized in the two groups: Phakic group with 80 eyes and pseudophakic group with 80 eyes in a total sample of 160 eyes as shown in Table 1.

Table 1: Pseudophakic and Phakic Eyes

Groups	Frequency	Percentages %
Pseuduophakic Eyes	80	50.0%
Phakic Eyes	80	50.0%
Total	160	100.0%

All included sample was examined for right and left eye separately. Among them 86 (54%) were right eyes and 74 (46%) were left eyes as shown in Table 2.

Table 2: Distribution of Eyes

Eyes	Frequency	Percentages
Right Eye	86	53.8%
Left Eye	74	46.3%
Total	160	100.0%

The visual acuity both in Pseudophakic and phakic, 6/18 were in 5 (6%) pseudophakic eyes, 6/12 in 8 (10%), 6/9 in 32 (40%) and 6/6 in 3 (44%) eyes. But in phakic 6/18 were 3 (4%), 6/12 in 5 (6%), 6/9 in 14 (18%) and 6/6 in 58 (73%) eyes as shown in Table 3.

Table 3: Distance Visual acuity

Visual acuity	Groups				Total Eyes
	Pseudophakic	Percentage %	Phakic	Percentage %	
6/18	5	(6%)	3	(4%)	8
6/12	8	(10%)	5	(6%)	13
6/9	32	(40%)	14	(18%)	46
6/6	3	(44%)	58	(73%)	93
Total	80	(100%)	80	(100%)	160

The near vision in both groups pseudophakic and phakic; N6 in 45 (52%) pseudophakic eyes and N8 in 35(47%) pseudophakic eyes, but in phakic 41 (48%) eyes with N6 and 39 (53%) eyes with N8 as shown in Table 4.

Table 4: Near Visual Acuity

Group	Near Vision				Total Eyes
	N6	Percentage %	N8	Percentage %	
pseudophakic	45	52%	35	47%	80
Phakic	41	48%	39	53%	80
Total	86	100%	74	100%	160

In Pseudophakic group myopes were 15 (19%), hyper metropes 12 (15%), astigmatic 32 (40%) and 21 (26%) had no refractive error. In phakic group myopes were 12 (15%), hypermetropes 7 (9%), astigmatic 17 (21%) and 44 (55%) had no refractive error as shown in Figure 1.

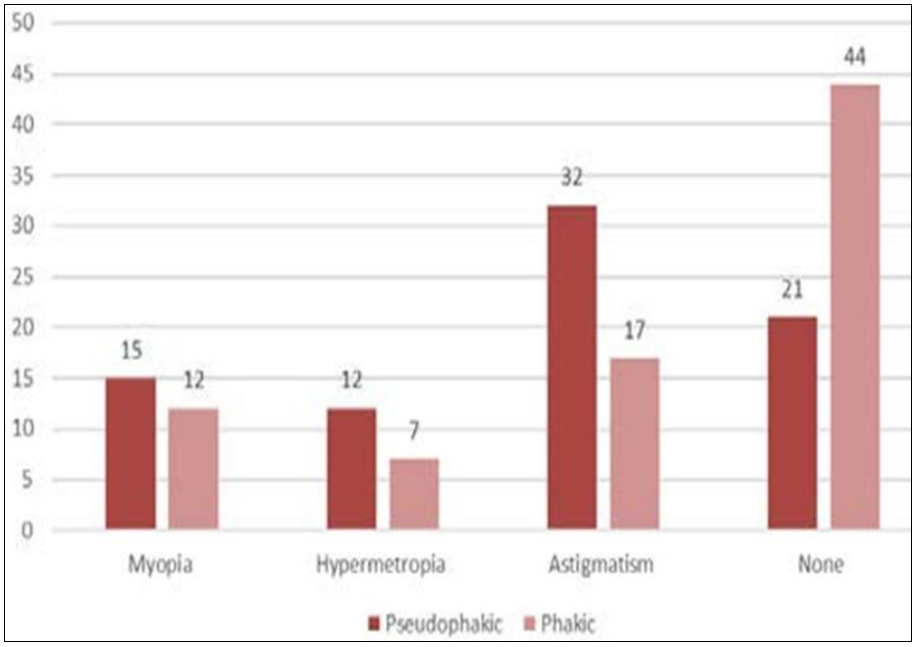

Fig 1: In Pseudophakic group myopes were 15 (19%), hyper metropes 12 (15%), astigmatic 32 (40%) and 21 (26%) had no refractive error. In phakic group myopes were 12 (15%), hypermetropes 7 (9%), astigmatic 17 (21%) and 44 (55%) had no refractive error

Among pseudophakic group; tritonopia in 32 (40%), deutronopia in 10 (13%), protonopia in 8 (10%), combined tritonopia + protonopia in 6 (8%), combined deutran + tritan in 4 (5%), combined protan + deutran in 2 (3%) eyes while 18 (23%) eyes showed no color vision defect as shown in Figure 2.

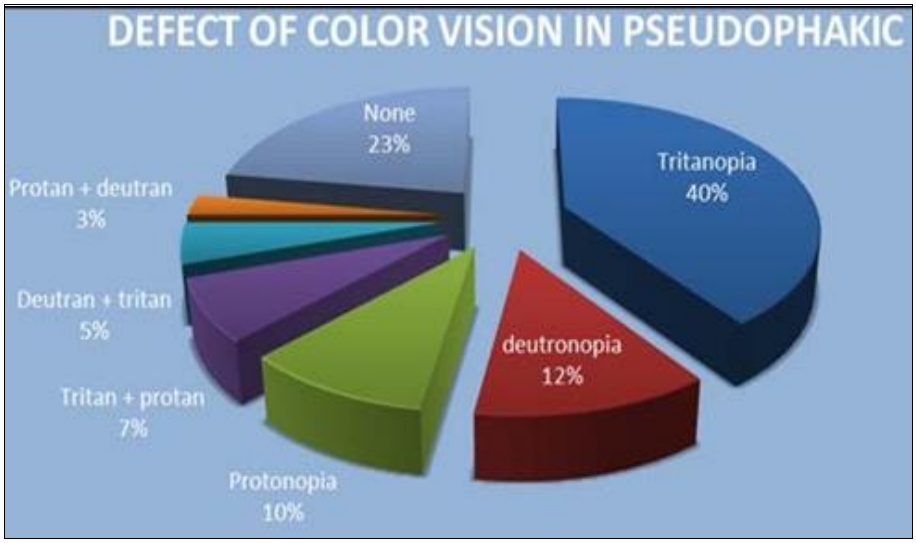

Fig 2: Defect of color vision in Pseudophakic Group

In phakic group: Tritonopia in 7 (9%) eyes and Deutronopia 1(1.00%) while 72 (90%) had no defect as shown in Figure 3

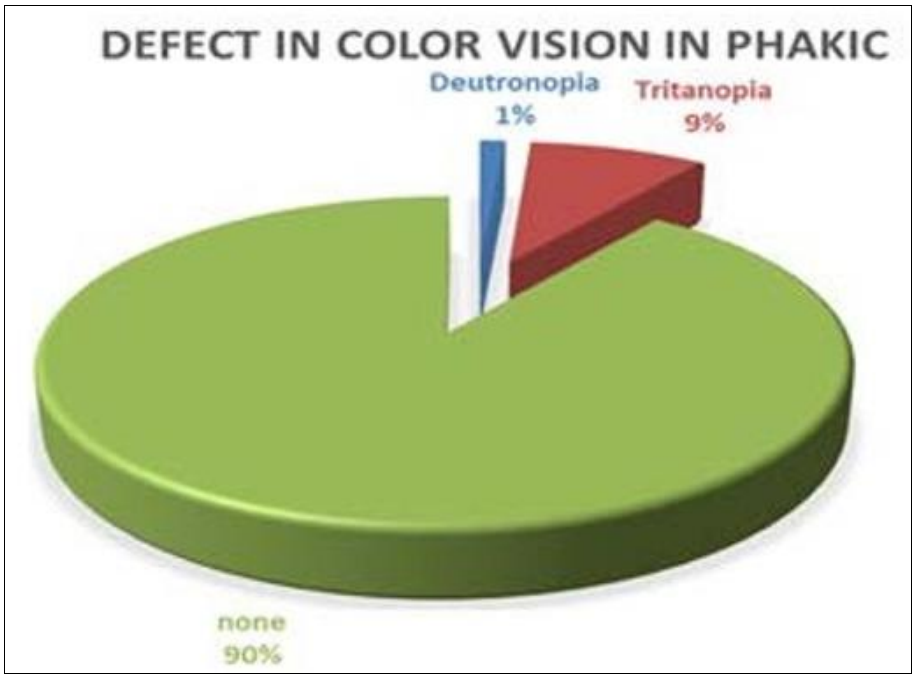

Fig 3: Defect of color vision in phakic Group

The below Figure 4 shows comparison between pseudophakic and phakic groups, the pseudophakic eyes were more sensitive to tritanopia 32 (40%) as compared to phakic 7 (9%), than deutronopia 10 (13%) in pseudophakic group and only 1(9%) in phakic group, protonopia 8(10%) in pseudophakic and 0 (zero) in phakic and the combined tritonopia+protonopia defect 6 (8%) in pseudophakic but 0 (zero) in phakic, then combined deutronopia + tritonopia 4 (5%) in pseudophakic and 0 (zero) in phakic group, combined protonopia + deutronopia 2 (3%) in pseudophakic and 0 (zero) in phakic while 18 (23%) in pseudophakic and 72 (90%) in phakic group has no color vision defect.

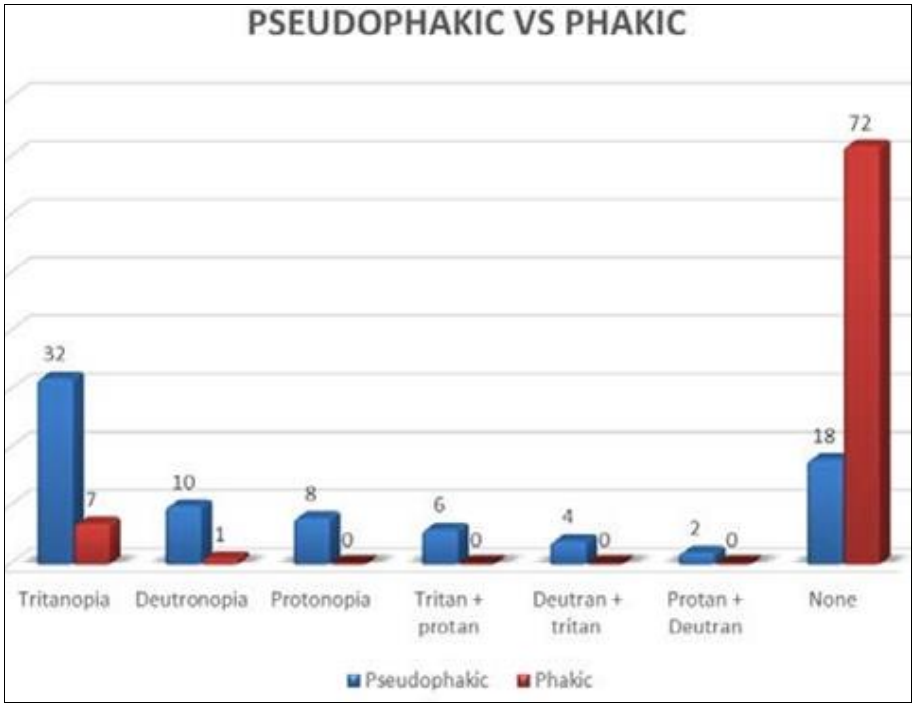

Fig 4: Color vision defect in Pseudophakic Group vs Phakic Group

Discussion

In present study Pseudophakic group was more sensitive to tritonopia which contradict with the results of another study where anomaloscope and the 100-hue test were used indicating that the pseudophakic eyes were more sensitive to red and less sensitive to blue than healthy phakic eyes [15]. In a study carried out on sixty-eight eyes of 40 diabetic patients, divided into four subgroups at different stages of diabetic retinopathy and 20 eyes of 10 healthy individuals as controls showed that the Ishihara pseudo iso-chromatic plates test; only 51% of diabetic patients passed the test, 28% failed and the remaining 21% were suspects while 90% of controls passed and only 10% failed. Only 10% of controls failed the Farnsworth D-15 test due to Protanopia, while 50% of the diabetics failed the test, with variable dyschromatopsia mainly Tritanopia and combined color vision deficiencies [16]. Contrarily our study excluded systemic diseases. Another cross-sectional study used the Farnsworth 100 hue test and Pickford Nicholson anamolscope in pseudophakic, phakic and spectacle aphakic eyes to determine the little difference in their color perception. The pseudophakic eyes are highly sensitive to red and low sensitive to blue when compared with aphakic while in our study Panel D15 was used to assess color vision defect and shared contrary results showing that pseudophakic eyes were sensitive to blue. [17] A study showed that blue-yellow defects were becoming increasingly prevalent with increasing age [18] similar to our study's results. Another study compared color differentiation of 30 phakic and 30 pseudophakic eyes, using the Farnsworth-Munsell 100-hue test and they found no significant difference between the two groups as regards differentiation of colors although theoretically it could be expected that color differentiation will be better in eyes with a synthetic intraocular lens and subject's age [19]. has greatest influence on color sense while our study showed that pseudophakic group is more sensitive to blue defect as compared to phakic group.

Conclusion

The study concluded that tritonopia was more commonly present in Pseudophakic group while majority of subjects in Phakic group did not show color vision defect.

Conflict of Interest

Not available

Financial Support

Not available

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How to Cite This Article
Rangaiah EP, Latha GM. Comparing color vision impairment in natural lens and artificial lens groups. International Journal of Medical Ophthalmology. 2022;4(1):96-100.