

ORIGINAL ARTICLE

The Comparison of Visual Acuity After Congenital Cataract Surgery between Children ≤ 2 Years and $> 2-17$ Years

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ARTICLE INFO

Article history:

Received 21 September 2020

Received in revised form 23

October 2020

Accepted 27 October 2020

Available online 31 October 2020

Keywords:

Congenital cataract,

Cataract surgery,

Visual acuity.

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ABSTRACT

Introduction: Congenital cataract is turbidity occurs in eye lens that present at birth or immediately after. We aim to find out visual acuity after congenital surgery between children under 2 years old and 2-17 years old after following up 3, 6, 12 months

Methods: This was a cross-sectional study. Data were gathered from medical record of congenital cataract aged ≤ 2 years and $> 2-17$ years including age of surgery, frequency of eyes, sex, laterality, and visual acuity of patients with best corrected visual acuity (BCVA). All data analyzed using Mann-Whitney test.

Results: 41 children (67 affected eyes) in which 45 eyes that were operated at aged ≤ 2 years and 22 eyes were operated at aged $> 2-17$ years. There was average difference of visual acuity between age group of ≤ 2 years and $> 2-17$ years while following-up 3 months (1.60 ± 0.34 logMAR, 1.23 ± 0.67 logMAR, $p = 0,003$). Whereas in follow up 6 months (1.23 ± 0.47 logMAR, 1.15 ± 0.68 logMAR, $p = 0,242$) and 12 months (0.94 ± 0.47 logMAR, 0.96 ± 0.44 logMAR, $p = 0,840$), there were no difference significant average of visual acuity.

Conclusion: Visual acuity after following-up 3 and 6 months in age group of $> 2-17$ years were better than age group of ≤ 2 years, whereas after following-up 12 months in age group ≤ 2 years, it was obtained that visual acuity was better than age group of $> 2-17$ years.

Introduction

Congenital cataract is the turbidity in eye lens that arises at birth or after. It can occur unilaterally or bilaterally. World Health Organization (WHO) through the program of Vision 2020 : The right to sight, in which there are no people who had visual impairment and it aims to eliminate the number of blindness in 2020. the treatment of congenital cataract cases are quite complicated. However, by using proper screening, accuracy of diagnosis, and management and routine follow up are able to give prospect in developing better visuality.¹

Visual acuity is a measurement angularly related to inspection distance to see minimum object size in certain distances. Measurement of visual acuity in children is divided into 2 which are preverbal ($< 2,5$

years old) and verbal (> 2.5 years old).² Age of child who will be operated also affect visual acuity level in the future. Children who are operated in age of ≤ 2 years have sizable inflammation risk and the complication which is often found is severe fibrinous uveitis occurring 4-8 days after being conducted extraction. However, it is in critical period so visual acuity still can develop better. Whereas children on age group of > 2 years certainly have pass critical period and also have big risk of amblyopia. The big visual deprivation also makes visual acuity to get worse. Therefore, extraction of congenital cataract is recommended at age of ≤ 2 years because within in critical period, the eye nerve plasticity is still immense and the risk of deprivational amblyopia is smaller. It means that visual impairment can be handled and development progress going better,



thus risk of blindness can be minimized.³

Congenital cataract has worse visual prognosis than cataract in adults. The dimension of visual acuity depends on factors such as cataract onset, morphology and thickness, time of surgery, rehabilitation options, and treatment of amblyopia.¹ There are 62.2% children with bilateral cataract reach visual acuity of 0.3 logMAR, whereas in unilateral cataract cases were only 30.9% that can reach the similar visual acuity.⁴ Unilateral congenital cataract should be operated as soon as possible because the risk of amblyopia is smaller than bilateral congenital cataract.² Until now, there is still lack of data regarding post operative visual of children with congenital cataract in Indonesia. Thus, we aim to conduct research about postoperative visual acuity of ≤ 2 years and $>2-17$ years.

Methods

Before conducting the research, it had been carried out the ethical feasibility test by Ethics Committee of Dr. Soetomo General Hospital Surabaya (0102/KEPK/III/2018). This research was a retrospective cross sectional study conducted from January 2017 to August 2018. Research procedure and collecting the data were carried out using secondary data from medical records of patients who underwent congenital cataract extraction and implantation of planting lenses in age of ≤ 2 years and $>2-17$ years within periode January - July 2018 at Eye Outpatient Installation Division of Paediatrics- Ophthalmology Dr. Soetomo General Hospital Surabaya.

Inclusion criteria was postoperative of congenital cataract with installation of intraocular planting lens with measurable vision after follow-up in 3 months, 6 months and 12 months with best corrected visual acuity (BCVA). Exclusion criteria were congenital cataract patients with visus result which was obtained with light perception (+) or equal to 1/~ and patients did not cooperative that the visus was not measured while following-up in 3 months, 6 months and 12 months.

Collected data were then analyzed using SPSS for Windows version 21 (IBM Corp., Armonk, NY) and used normality test, homogeneity test, and Mann-Whitney test. The data were presented as mean \pm SD. $p < 0.05$ was considered statistically significant.

Results

From total 41 patients that underwent surgery with 67 eyes suffering congenital cataract (for age of ≤ 2 years were 45 eyes and $>2-17$ ages were 22 eyes). Patients met inclusion criteria, consisted of 17 males (41.46%) and 24 females (58.54%), 15 children (36.59%) suffered nystagmus and 7 children (17.07%) suffered posterior capsular opacity (PCO). These variabls were shown on Table 1 and 2. The average age of congenital cataract was 2.35 ± 2.34 years and the youngest age was 3 months and the oldest was 9.5 years. 26 children (63.42%) suffered bilateral congenital cataract and 15 children (36.59%) suffered unilateral congenital cataract (Table 4).

Table 1. Patient Characteristic

Variable	n	%
Age of surgery		
≤ 2 years	27	65.85%
$> 2-17$ years	14	34.15%
Frequency of eyes		
≤ 2 years	45	67.16%
$> 2-17$ years	22	32.84%
Gender		
Male	17	41.46%
Female	24	58.54%
Nystagmus		
≤ 2 years	9	33.33%
$> 2-17$ years	6	42.86%
Posterior Capsular Opacity (PCO)		
≤ 2 years	2	7.41%
$> 2-17$ years	5	35.71%

Table 2. Distribution of Congenital Cataract Sex

Gender	Age of Surgery		n
	≤ 2 years	$> 2-17$ years	
Male	11 (40.74%)	6 (42.86%)	17 (41.46%)
Female	16 (59.26%)	8 (57.14%)	24 (58.54%)

Table 3. Distribution of Age of surgery

Age of surgery	Eyes (n)	Average (\pm SD)
≤ 2 years	45	1.06 \pm 0,75
$> 2-17$ years	22	5.00 \pm 2,29

Table 4. Distribution of Congenital Cataract Laterality

Age of Surgery	Unilateral	Bilateral	n
≤ 2 years	9 (33.33%)	18 (66.67%)	45 (100.00%)
$> 2-17$ years	6 (42.86%)	8 (57.14%)	22 (100.00%)

Table 5. Visual Acuity Comparison after surgery between age group of ≤ 2 years and $>2-17$ years

Age of Surgery	Followed-up	Eye frequency (n)	Average (\pm SD)	P Value ¹
≤ 2 years	3 months	45	1.60 \pm 0.34	0.003
$> 2-17$ years		22	1.23 \pm 0.67	
≤ 2 years	6 months	45	1.23 \pm 0.47	0.242
$> 2-17$ years		22	1.15 \pm 0.68	
≤ 2 years	12 months	45	0.94 \pm 0.47	0.840
$> 2-17$ years		22	0.96 \pm 0.44	

¹Using Mann-Whitney Test, there was average difference of visual acuity between age group of ≤ 2 years and $>2-17$ years while following-up 3 months, $P < 0.05$, indicating significant effects of the factors on BCVA (logMAR).

Visual acuity in age group of ≤ 2 years

The greatest number of visual acuity was 1.92 logMAR with 17 children (37.78%) and the best visual acuity was 0.78 logMAR found in 3 children (6.67%) after being followed up in 3 months (Figure. 1a). The visual acuity was 0.30 logMAR found in 4 children (6.67%) who were operated in age of ≤ 2 years after being followed up in 6 months (Figure. 1b). The best visual acuity of 0.30 logMAR of 7 children (15.56%) after being followed up in 12 months (Figure. 1c).

Visual acuity in age group of $>2-17$ years

The greatest number of visual acuity was 1.18 logMAR after being followed up in 3 months and the best visual acuity was 0.30 logMAR found in 2 children (9.09%) (Figure. 2a). The best visual acuity was 0.30 logMAR found in 2 children (9.09%) from 22 subjects who were operated in age of $>2-17$ years (Figure. 2b) and after being followed up in 12 months it was obtained that the best visual acuity was 0.30 logMAR found in 2 children (9.09%) (Figure. 2c).

The Comparison of Visual acuity in age group of ≤ 2 years and $>2-17$ years after congenital cataract surgery in Dr. Soetomo General Hospital from July 2017 to July 2018

Based on Table 5 postoperative of visual acuity in age of ≤ 2 years after following-up in 3, 6, and 12 months had average of 1.60 ± 0.34 logMAR, 1.23 ± 0.47 logMAR, and 0.94 ± 0.47 logMAR. The value of most visual acuity while

following up in 3 months was 1.92 logMAR. Following up after 6 months was 1.18 logMAR and 1.48 logMAR and follow-up after 12 months was 0.78 logMAR (Figure. 1 and 3).

After undergoing las follow-up, it was obtained 51 eyes that had BCVA of 20/40 (0.3 logMAR), 38 eyes reached BCVA of 20/100 (0.7 logMAR), 26 eyes had worse BCVA than 20/200. In the case of unilateral cataract with IOL, there were only 2 eyes that reached BCVA of 20/40 and 6 eyes that were worse than 20/200 after conducting last follow-up. Post-operative of visual acuity of $> 2-17$ years after 3-month follow-up had a mean of 1.23 ± 0.67 logMAR, after a 6-month follow-up the average was 1.15 ± 0.68 logMAR, and after a 12-month follow-up the average was 0.96 ± 0.44 logMAR. The highest score of visual acuity at 3 months follow-up was 1.18 logMAR and 1.48 logMAR, at 6 months follow-up was 1.18 logMAR, as well as at follow-up after 12 months was 0.78 logMAR (Figure. 2 and 3).

Based on statistic analysis of comparison of age group ≤ 2 years and $>2-17$ years follow-up in 3 months after surgery, there was a significant difference ($p=0.003$). It showed that visual acuity of $>2-17$ years had better visual acuity than operation ≤ 2 years old. After being followed-up in 6 months ($p=0.242$) and 12 months ($p=0.840$) in two group of operation age which meant that there was no difference significant average of visual acuity (Table 5).

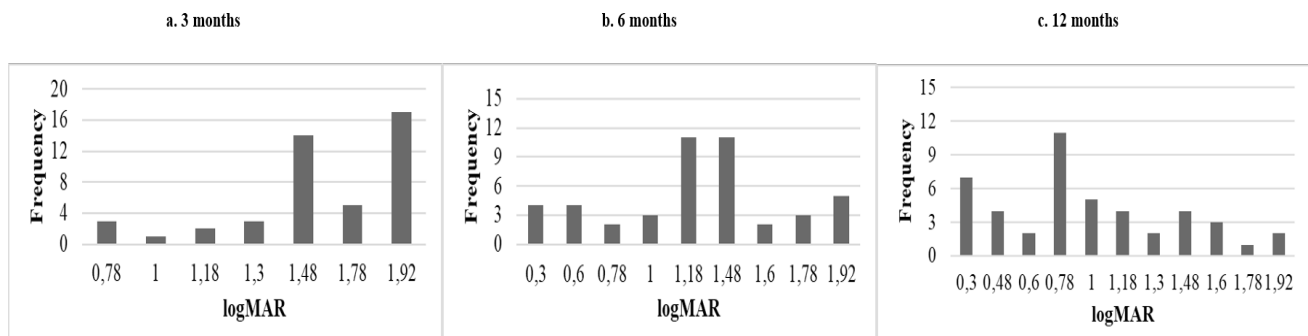


Figure 1. Visual acuity in age group of ≤ 2 years after following-up in 3, 6, and 12 months

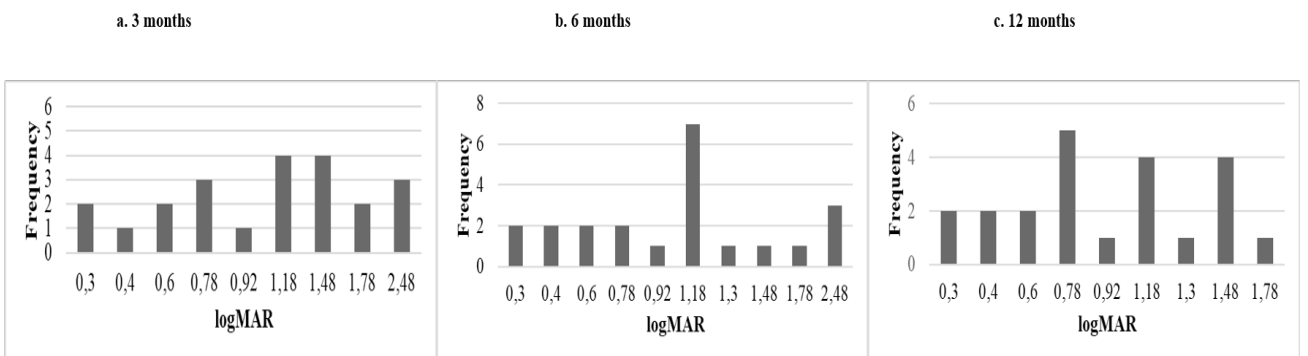


Figure 2. Visual acuity in age group of $>2-17$ years after following-up in 3, 6, and 12 months

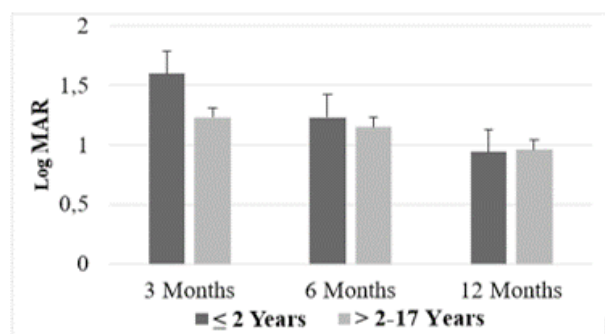


Figure 3. The Comparison of Visual acuity in age group of ≤ 2 years and $>2-17$ years after congenital cataract surgery in Dr. Soetomo General Hospital Surabaya from July 2017 to July 2018.

Discussion

Based on total subject of the research about patients with congenital cataract of 41 subjects, including 17 male (41.46%) 24 female (58.54%). Previous research revealed that most cases of congenital cataract found in male.⁵ Patients with congenital cataract were dominated by males of 65 patients and females of 45 patients either for bilateral or unilateral case, however the correlation of gender on congenital cataract is still unknown.⁶

Critical period is development period of visual acuity since birth until 3-5 years old. Age for surgery is suggested not surpassing critical period because when there is visual impairment such as cataract in critical period and get a proper treatment, the visuality development would be better by age,⁷ because the eye nerve plasticity is still immense to develop and the risk of deprivation amblyopia is small. It may different if it has surpassed the critical period where the risk of amblyopia and visual deprivation become bigger and the visual acuity can get worse.⁸ Based on cohort study, children who were operated in age of <1 year had high risk to have worse visus than age for operation of 1 year. It is because infant already has cataract in the womb and it develop after birth. Children who were operated in <1 year only reached best visual acuity of 0.3 logMAR, whereas children who were operated in >1 year reached visual acuity of 0.1 logMAR.⁴

We found 15 (36.59%) children suffered from congenital cataract with nystagmus. Nystagmus basically affected the critical period of visual development. Thus, it caused worse visuality condition compared to non-nystagmus children.⁴ Other abnormalities of eye abnormalities that also had a significant effect on prognosis included: strabismus, Persistent hyperplastic primary vitreous (PHPV), persistent pupillary membrane (PPM), small eyeball, and small corneal disorders.⁹ 81 patients of pre-operation who had nystagmus indicated that recovery of visual function would become worse if there was operation delay.⁷

7 children had PCO after cataract extraction.¹⁰ It caused worse visual acuity in patient with congenital cataract. PCO develops in young children with development level of 100% in children who were operated in age of ≤ 4 years when the posterior capsule was intact.³ The incidence of PCO for the axial axis was higher at age of 3 months of operation than

6 months, the majority of some nata complications arise during the mid-term period from 6 months to 2 years after surgery. The presence of PCO and high IOP abnormalities were often found in the postoperative period.¹¹

Children who have cataract in their eyes, they can only differ dark or bright light by diecting and closing the eyes if there is light until age of 4 weeks. Children could do fixation and move the eyes when there was a light source that was brought near to the age of 4-6 months. The presence of congenital cataracts that made the lens in the infant's eyes slightly cloudy made the visual acuity to get worse.^{2,12} Children who were operated cataract in age of ≤ 2 years had quite lark inflammation risk and the complication which was often found was severe fibrinous uveitis yaquite happened in 4-8 days after cataract extraction.² Children who were operated in age of ≤ 2 years with follow-up in 3 months, from 49 eyes, there were 10 which were operated to reach best visual acuity of 6/18. Most of them had value of visual acuity $<6/18-6/60$, but 5 eyes had poor visual acuity of $<3/60$. Patients with this visual acuity had complication in their eyes, such as glaucoma, amblyopia, corneal edema, and shallow anterior chamber. Children with congenital cataract in age of ≤ 2 years still have the biggest axial length growth (AXL), neural plasticity is still flexible, and various anatomical structures of the eye, especially the fovea, were still not perfect. The risk of complications was also quite large, namely the presence of a higher inflammatory process compared to the operating age group of $>2-17$ years.¹³

Proper visual acuity was also affected by intervention of cataract surgery to avoid the greater amblyopia deprivation, correction of visual outcome after surgery, successful prevention of intraoperative and postoperative complications. Cataract extraction and correction of afakia should be done immediately during the first month of life, in cases of unilateral congenital cataract intervention before the age of 6 weeks could provide effectiveness for visual development, especially visual acuity.^{5,10} The visual acuity results of the vision were not influenced by gender differences, the poor results of visual acuity could be caused by the presence of amblyopia that had exceeded the critical period added by the presence of Nystagmus.^{14,15} The average number of operated children in India was 9 years old with a follow-up of 3 to 8 years, 149 children had BCVA $>6/18$. Many factors influence, among others: cataract type, type of surgery, intraocular lens type, age of operation, presence or absence of postoperative uveitis, and pre-operative visual acuity.¹⁶ IOL implantation during congenital cataract surgery was very mandatory because other methods for visual rehabilitation such as glasses and contact lenses were less suitable for use. The presence of visual deprivation caused the rate of vision in children to get worse, the incidence of PCO was the final complication that caused vision to get worse.¹⁶

Many factors that affected visual acuity at 3 months and 6 months follow-up at $>2-17$ years of operation were better than surgery in age age ≤ 2 years. A previous study explained that the mean visual acuity extracted at 6-month operating age was smaller than the 3-month operating age. There was a number of implications of these results. First, the average infant sleep time was 15 hours a day, this indicated that light disturbance and amblyopia deprivation were not a key factor influencing the development of visual acuity in newborns with congenital cataracts. Secondly, younger

infants had a greater risk of experiencing side effects during administration of general anesthesia because there was not enough maximal work from the cardiovascular, pulmonary, thermoregulation, gastrointestinal, liver, and kidney systems. In some cases, it was quite difficult and more risky to treat patients with amblyopia. Third, the visual system would retain plasticity with significant individual differences, even when early blindness was longer than the critical period.^{10,17}

This study has several limitations, such as: (1) in some medical records of patients with congenital cataracts. They did the examinations only for about 6 months postoperative. Therefore the data for 1 year examinations can't be completed, so it is taken from the previous BCVA (2) Some medical records do not include the pre-operative visual acuity, so that some data is considered as light perception (+).

Conclusion

This research aims to find out visual acuity after congenital surgery between children ≤ 2 years and $>2-17$ years old after following up 3, 6, and 12 months. Visual acuity after follow-up 3 months and 6 months in age group of $>2-17$ years is better than age group of ≤ 2 years, whereas after follow-up 12 months in age group of ≤ 2 years is obtained that visual acuity is better than in age group of $>2-17$ years.

Acknowledgement

1. Indri Wahyuni, dr., SpM(K). Department of Ophthalmology, Faculty of Medicine, Airlangga University. As Cataract and Refractive Surgery Consultant in Dr. Soetomo General Hospital
2. Dr. Nurwasis, dr., SpM(K). Department of Ophthalmology, Faculty of Medicine, Airlangga University. As head of Department of Ophthalmology
3. Atika, S.Si., M.Kes., As Statistics evaluation consultant

Conflict of Interest

The author stated there is no conflict of interest

References

1. Zhang L, Wu X, Lin D, et al. Visual Outcome and Related Factors in Bilateral Total Congenital Cataract Patients: A Prospective Cohort Study. *Scientific Reports*. 2016; 6: 31307.
2. Yorston D, Wood M and Foster A. Results of Cataract Surgery in Young Children in East Africa. *The British Journal of Ophthalmology*. 2001; 85: 267-71.
3. Batur M, Gül A, Seven E, Can E and Yaşar T. Posterior Capsular Opacification in Preschool- and School-Age Patients after Pediatric Cataract Surgery without Posterior Capsulotomy. *Turkish Journal of Ophthalmology*. 2016; 46: 205-8.
4. Bonaparte LA, Trivedi RH, Ramakrishnan V and Wilson ME. Visual Acuity and Its Predictors after Surgery for Bilateral Cataracts in Children. *Eye (London, England)*. 2016; 30: 1229-33.
5. Lundvall A and Kugelberg U. Outcome after Treatment of Congenital Unilateral Cataract. *Acta Ophthalmologica Scandinavica*. 2002; 80: 588-92.
6. Rong X, Ji Y, Fang Y, Jiang Y and Lu Y. Long-Term Visual Outcomes of Secondary Intraocular Lens Implantation in Children with Congenital Cataracts. *PloS one*. 2015; 10: e0134864.
7. Shenoy BH, Mittal V, Gupta A, Sachdeva V and Kekunnaya R. Complications and Visual Outcomes after Secondary Intraocular Lens Implantation in Children. *American Journal of Ophthalmology*. 2015; 159: 720-6.
8. Nishina S, Noda E and Azuma N. Outcome of Early Surgery for Bilateral Congenital Cataracts in Eyes with Microcornea. *American Journal of Ophthalmology*. 2007; 144: 276-80.e1.
9. Davidorf JM. Pediatric Refractive Surgery. *Journal of Cataract and Refractive Surgery*. 2000; 26: 1567-8.
10. Lin H, Yang Y, Chen J, et al. Congenital Cataract: Prevalence and Surgery Age at Zhongshan Ophthalmic Center (ZOC). *PloS one*. 2014; 9: e101781.
11. Lesueur LC, Arné JL, Chapotot EC, Thouvenin D and Malecaze F. Visual Outcome after Paediatric Cataract Surgery: Is Age a Major Factor? *The British Journal of Ophthalmology*. 1998; 82: 1022-5.
12. Gogate PM, Sahasrabudhe M, Shah M, et al. Long Term Outcomes of Bilateral Congenital and Developmental Cataracts Operated in Maharashtra, India. *Miraj Pediatric Cataract Study III*. *Indian Journal of Ophthalmology*. 2014; 62: 186-95.
13. Nash DL, Diehl NN and Mohny BG. Incidence and Types of Pediatric Nystagmus. *American Journal of Ophthalmology*. 2017; 182: 31-4.
14. Duke RE, Adio A, Oparah SK, Odey F and Eyo OA. Evaluation of a Public Child Eye Health Tertiary Facility for Pediatric Cataract in Southern Nigeria I: Visual Acuity Outcome. *The Open Ophthalmology Journal*. 2016; 10: 119-25.
15. Kishiki E, Shirima S, Lewallen S and Courtright P. Improving Postoperative Follow-Up of Children Receiving Surgery for Congenital or Developmental Cataracts in Africa. *Journal of AAPOS : The Official Publication of the American Association for Pediatric Ophthalmology and Strabismus*. 2009; 13: 280-2.
16. Giles K, Christelle D, Yannick B, Fricke OH and Wiedemann P. Cataract Surgery with Intraocular Lens Implantation in Children Aged 5-15 In Local Anaesthesia: Visual Outcomes and Complications. *The Pan African Medical Journal*. 2016; 24: 200.
17. Anstice NS and Thompson B. The Measurement of Visual Acuity in Children: An Evidence-Based Update. *Clinical & Experimental Optometry*. 2014; 97: 3-11.