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ASSESSMENT OF THE ACCURACY OF SPECTACLE LENS PARAMETERS IN ASMARA, ERITREA

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ABSTRACT

Background: Spectacles are the most common, easy and affordable method of providing refractive correction to individuals with refractive error[1]. If dispensed correctly, they provide good visual and physical comfort, so accurate dispensing is critical to avoid the discomfort that may follow. The aim of this research is to assess the accuracy of spectacle lens parameters with their prescription. **Method:** This crossectional analytical study was conducted from July 2017-October 2017 in Asmara, Eritrea. 204 individuals were included in this study. In single vision glasses refractive power, IPD and OCD were checked. In addition to these fitting height and segment height was checked in bifocal glasses. Site of dispensing and if measurement was taken at that site or not was questioned to all 204 participants. After taking the relevant measurements, the result was checked against the prescription paper and further was compared with ANSI tolerance limit. Any parameter outside the tolerance limit was considered as incorrect dispensing. The data was analyzed using SPSS version 20. **Results:** A total of 204 spectacles of 204 individuals were assessed. The mean age was 37.79(range 6-70). Males accounted for 118(57.84%) and 86(42.16%) were females. Out of the 204 spectacles, 196 were single vision and the remaining 8 were bifocals. The difference in spherical, cylindrical and axis between the prescription and dispensed lenses were statistically significant of $p<0.01$ in single vision lenses while these were statistically not significant of $p>0.01$ in bifocal lenses. The calculated HPE in single vision was statistically significant of $p<0.01$ where as in bifocal it was not ($p>0.01$). The difference between the segment height and fitting height in bifocals was found to be statistically significant ($p<0.01$). **Conclusion:** The results of this study showed that all parameters were inaccurately dispensed with IPD error accounting the most. Power and axis error held values lower than that of the IPD. This signifies the need for improved dispensing practice as well as careful professional workup.

KEYWORDS
Parameters, Dispensing practice and Spectacle Lens.

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INTRODUCTION

Background

Spectacles are the most common, easily available and affordable method of correcting refractive error[1]. Even though there are other alternatives such as contact lens and refractive surgery yet spectacles are still demanded despite their long usage. Dispensing an appropriate spectacle alters the person's visual

world in a positive way. Hence, there are certain parameters that need to be considered while prescribing and dispensing. The parameters studied in this research are, power, axis, IPD, fitting height and segment height. Besides lens stress and lens swapping were assessed as they can arise during lens fitting. As these parameters held a crucial value in dispensing a spectacle, if they lie outside the tolerance limit they may result into difficulties. [Visual and physical difficulties]. These difficulties result into noncompliance which further affects the person's quality of life[2].

Spectacles being the most commonly used correction modalities especially in developing countries, there is a need to assess how they are being dispensed. Globally there has been few studies done regarding this topic, very few in our region and none in Eritrea. This study is designed to determine the accuracy of spectacle lens parameters dispensed in Asmara. Through this study, dispensers, prescribers as well as spectacle wearers will gain an insight on spectacles. This research will also provide a baseline data for further researches to be carried out.

METHODS

This cross sectional analytical study was approved by the Ethical Committee of Asmara Collage of Health Sciences and Ministry of Health. The study protocol followed all the relevant guidelines issued in the Helsinki Declaration. An informed verbal consent from adult participants and an ascent from legal guardians of the young children were taken. The purpose and procedures of the study was explained to the subjects in detail and all the verification processes was done in front of the subjects. The study was conducted in Asmara, the capital city of Eritrea from July to October 2017 and the study population was patients who visited Berhan National Eye Referral Hospital during the course of the research period. Purposive sampling was used to draw the sample from the study population. The samples drawn were called to the Asmara Collage of Health Sciences, department of Optometry to taken relevant measurements. 204 participants were part of this study. Subjects from the age of 6-70 years and who were prescribed with distance, near or both glasses from July-October 2017 were included in the study. Whereas subjects who had readymade glasses and glasses which incorporated prismatic correction were excluded, similarly patients who are not residents of Asmara were excluded.

A Performa was prepared and used to record all data which were collected from the patients and from the measurements taken. It included three sections, demographic details, prescription details and measurement results. The demographic section included age and gender of the patients. The prescription details were taken from the prescription paper of the patients. The measurement section included the dispensed details of a given lens which are; power, IPD, OCD, stress presence or absence, and other information (such as site of dispensing and responses for questions whether IPD measurement was taken or not).

Different types of instruments were used to take the relevant measurements. First, IPD and fitting height were measured from the patients using Pupillometer and PD rule respectively. Before taking all the measurements, the spectacles were standard aligned. After that, power and axis measurement was taken by Red star manual Lensometer. Optical center of the lenses was also marked using the Lensometer. Then using the PD rule, the optical center distance and segment height were measured from the lens. Finally, lenses were checked for presence of stress using Polariscope. ANSI was utilized as a set standard criterion for the verification of power, axis, horizontal prismatic effect and segment height errors for their tolerance[3].

SPSS version 20 was used to analyze the data. Pearson's correlation test was used to calculate the *p* value.

A *p* value of *0.01* with the confidence interval 99% was used to assess significance of the results. *p* value *< 0.01* was considered statistically significant and *p* value *>0.01* was considered statistically not significant.

RESULTS

Results Demographic Details

A total of 204 spectacles of 204 individuals were included in the study. The male subjects accounted

for 118(57.84%) of the participants and female subjects were 86(42.16%). The mean age was 37.79 (range of 6-70).

Results of single vision spectacles

Out of the 204 spectacles, 196 were single vision glasses. 186 spherical and 51 cylindrical lenses were found in the right lens, 186 spherical, 34 cylindrical lenses and 2 Plano lenses were found in the left lens.

The comparison in refractive distribution of the prescribed and dispensed lenses is expressed in a cross tabulation form as follows.

The tolerance of the right lens was checked, for the spherical power 135(68.9%) were found to be tolerable and 61(31%) were non tolerable. For the cylindrical power 29(14.8%) were tolerable and 22(11.2%) were non tolerable. For the axis 24(12.2%) were tolerable and 27(13.8%) non tolerable. The difference of this values with the prescription was statistically significant (p<0.01). The tolerance of the left lens was checked, for the spherical power 132(67.3%) were found to be tolerable, 64(32.7%) were non tolerable, for the cylindrical power 24(12.2%) were tolerable, 10(5.1%) were non tolerable and for the axis 20(10.2%) were tolerable and 14(7.1%) non tolerable. Similarly this difference was statistically significant (p<0.01).

Out of the 196 spectacles, 182(92.86%) were found to have HPE in which 83(42.36%) were BI and 99(50.51%) were BO for the right lens and 84(42.86%) were BI and 98(50%) were BO for the left lens.

The remaining 14(7.1%) spectacles had no prismatic effect. When the tolerance limit for spectacles with HPE was checked, 64(35.16%) were tolerable and 118(64.84%) were non tolerable. This variation was found to be statistically significant (p<0.01). 165(84.2%) of lenses were free from stress and 31(15.8%) were found to have stress. Any spectacle having stress even only in one lens were considered as stressed.

All 196 subjects who received single vision lenses were asked about the dispensing site and whether IPD measurement was done at dispensing site, 151(77%) of them said the spectacles were received from private sector dispensing outlet and IPD was not measured, 22(11.2%) of them received their spectacles from public sector dispensing outlet and IPD was not measured, however for 21(10.7%) subjects the IPD was measured when they receive their spectacles from private sector dispensing outlet, whereas IPD was measured for 2(1%) who received their spectacles from public sector dispensing outlet.

Results of bifocal spectacles

In this study only 8 bifocal spectacles were assessed, their distance power distribution was 1(12.5%) CHA, 4(50%) SH and 3(37.5%) PL. There were 5 spherical powers and 1 cylindrical power in the distance zone and 8 spherical powers and 1 cylindrical power in the near zone. The difference between the prescribed and dispensed power, axis and HPE of all the bifocals was not statistically significant (p>0.01).

The mean value of fitting height and segment height was 13.25 with a range from 11-16mm and 12.5 with a range from 10.5-16mm respectively. When the tolerance limit for the segment height of bifocals was checked, 6(75%) were non tolerable and 2(25%) were tolerable in which the difference with the fitting height was statically significant (p<0.01). All the bifocal lenses were stress free. The responses for the site of dispensing and measurement of IPD were, 5(62.5%), 2(25%) and 1(12.5%) as private not measured, private measured and government measured respectively.

In this study, IPD was measured in 26(12.74%) and not measured in 178(87.26%) of the participants. Out of the 26 individuals, IPD measured by the clinician accounted for 3(11.53%) and that measured by the optician was 23(88.46%). 19(73.07%) of those with measured IPD were found to be non-tolerable and 7(26.92%) were tolerable. In the current study no trifocal and progressive lenses were found and only one spectacle had swapped lenses.

DISCUSSION

Globally, it is estimated that around 153 million people are affected by visual impairment from treatable refractive error[4]. This data shows that there is a great need for refractive correction worldwide. According to a research done in Zoba Maekel, Eritrea in 2013 on prevalence of refractive error and

spectacle coverage, 77.8% out of 3200 subjects were found to have uncorrected refractive error[5]. This percentage implies the need for spectacle use.

Most of the time, patients do not complain of problems associated with spectacle wear. The patients believe that the glasses they have received are accurate and do not bother asking for verification or consultation. Some of them also ignore the problems thinking that it is only a matter of adaptation and some discontinue wearing the spectacles. Generally, all clients dispensed with inaccurate spectacles will have issues in performing their daily activities there by reduction in their quality of life. According to a research done in Oman in 2014, non- compliance was found to be the cause for reduced quality of life and incorrectly dispensed spectacles can be one of the main reasons for non-compliance to spectacle wear[2].

In this study Out of the 204 spectacles, 196 were single vision and the remaining 8 were bifocals. Trifocals and PALs were not encountered in any participant of the study. All the literatures assessed the accuracy of parameters in single vision glasses only and did not assess the Multifocals.

In the current study, we determined 15.8% simple hyperopia, 1.5% simple hyperopic astigmatism, 6.6% compound hyperopic astigmatism, 34.2% simple myopia, 3.6% simple myopic astigmatism, 13.8% compound myopic astigmatism and 24.5% presbyopia on the right lenses. On the left lens, 17.3% simple hyperopia, 1% simple hyperopic astigmatism, 4.6% compound hyperopic astigmatism, 38.8% simple myopia, 3.1% simple myopic astigmatism, 9.2% compound myopic astigmatism, 0.5% mixed astigmatism and 24.5% presbyopia were determined. Although the refractive distribution in the current study was generally incompatible with other studies done, the number of simple hyperopia and simple myopia lenses determined in this study were significantly higher.

The difference between right spherical, cylindrical and axis, and left spherical, cylindrical and axis values between the prescribed and dispensed lenses was statistically significant ($p<0.01$). This is opposite to the result found in a study which was conducted in India where these differences were found to be not statistically significant ($p>0.05$)[6]. Similar study done in Anatolia showed that only the difference in axis of the left lens was statistically significant ($p<0.001$)[7]. The errors committed in spherical power were more frequent in the left eye lens than in the right ones. In contrast, errors committed in the cylindrical power were more frequent in the right eye lens than in the left. Error related to axis of the lenses was similar in the right and left eye lenses.

IPD was measured and compared with OCD. The result was then converted in to horizontal prismatic effect and its tolerance was assessed using the ANSI guidelines for tolerance limit. The difference was shown to be statistically significant ($p<0.01$). This can be because the practitioner or the optician may forget to take the measurement. This opinion is supported by the fact that 87.26% of the subjects said no to the question of whether their IPD was measured by the optician or not. Similarly, IPD of these subjects was not measured by the clinician. In the study done in Anatolia, they simply considered the difference in IPD and OCD and the differences were converted to prismatic effect but tolerance limit was not considered. This may have increased the number of inaccurately dispensed spectacles and the results were statistically significant ($p<0.001$). 81% of their subjects said no to the question of whether IPD was measured or not, but this number was higher in our study[7].

From the total number of spectacles, technically 187 had prismatic effect out of which 126(67.38%) was outside the tolerance limit and 61(32.62%) within the tolerance limit. The most frequent encountered base direction for the HPE in single vision glasses was BO in our study while this was opposite for the study done in Anatolia. Lenses with no prismatic effect in their study held 71(7.1%) and 17(8.3%) in our study[7]. In the study done in Anatolia, 3 spectacles showed a change in place according to the prescription thus lens of the right eye was fitted to the left and vice versa. Similarly one spectacle was found to be swapped in this study[7].

In our study besides single vision lenses, spectacles with bifocal lenses were also assessed. There are limited studies comparing the prescription and

bifocal spectacle in the literature. In a study done in London 59 spectacle wearers were examined for spectacle non tolerance, having single vision, bifocals PALs and vocational lenses. When all the spectacles were compared non tolerance due to bifocal error was 0.8%. The reason for this non tolerance was not assessed in which inaccurately dispensed spectacle parameters could be one of the reasons[8].

In the current study, the spherical, cylindrical, axis, segment height, HPE and stress of the bifocal lenses was evaluated. The HPE for the distance portion as well as the difference in spherical, cylindrical and axial in both zones between the prescribed and dispensed bifocal was not statistically significant (P>0.01).

15.8% of the single vision spectacles assessed in this study were found to have stress. The remaining 84.2% of the single vision as well as all bifocals were free from stress. The reviewed literatures did not assess presence of stress in the lenses.

In this study, IPD was measured in 26(12.74%) and not measured in 178(87.26%) of the participants, this high number of unmeasured IPD could be because both the clinician and optician are not practicing it. 19(73.07%) of those with measured IPD were found to be non-tolerable and 7(26.92%) were tolerable. This shows that there is negligence in taking the IPD measurement or inaccurately calibrated instruments which results into wrong IPD measurement. Overall in this study the most inaccurately dispensed parameter was IPD which accounted for 118(64.84%). This was followed by power and axis error accounting for closer values. The most visited dispensing site by the participants was the private sectors (87.75%).

In the present study, we evaluated spectacles as a whole and ruled out the missing or wrongly incorporated parameters. The significant number of wrongly dispensed spectacles becomes the need to suggest the spectacle wearers to ask for verification of their spectacles before they receive them from the opticians. This fact is supported by a study done in India on the title of 'how often spectacle are dispensed as prescribed' which showed lower number of inaccurately dispensed spectacles when verification was made at the time of collection[6]. This fact is supported by a study done by Mwanza and Kabasele, 'Controlling the spectacles after they are prepared can be deemed as a solution to reduce problems related to spectacles'[9]. Prospective controlled studies evaluating spectacles and how they are being made in regard of the users with a large number of subjects are still needed in the future to reduce problems associated with spectacle usage.

Table No.1: Comparison between dispensed and prescribed refractive error distribution of right lens (RX_OD- prescribed refractive error, DX_OD- dispensed refractive power)

S.No	Count		DX_OD								Total
			CHA	CMA	P	SH	SHA	SM	MA	SMA	
1	RX_ OD	CHA	11	0	0	1	1	0	0	0	13
		CMA	0	21	0	0	0	0	0	0	21
		MA	1	0	0	0	0	0	0	0	1
		P	0	0	48	0	0	0	0	0	48
		SH	0	0	0	30	0	1	0	0	31
		SHA	1	0	0	0	2	0	0	0	3
		SM	0	4	0	0	0	65	0	0	69
		SMA	0	2	0	0	0	1	0	7	10
2	Total		13	27	48	31	3	67	0	7	196

Table No.2: Comparison of refractive distribution between prescribed and dispensed left lenses (RX_OS- prescribed refractive error, DX_OS- dispensed refractive power)

S.No	Count		DX_OS									Total
			CHA	CMA	MA	P	PL	SH	SHA	SM	SMA	
1	RX_ OS	CHA	7	0	0	0	0	1	0	0	0	8
		CMA	0	11	0	0	0	0	0	3	0	14
		MA	0	0	1	0	0	0	0	0	0	1
		P	0	0	0	48	0	0	0	0	0	48
		PL	0	1	0	0	2	0	0	0	0	3
		SH	0	0	0	0	0	33	1	0	0	34
		SHA	1	0	0	0	0	0	1	0	0	2
		SM	0	5	0	0	0	0	0	73	0	78
		SMA	1	1	0	0	0	0	0	0	6	8
2	Total		9	18	1	48	2	34	2	76	6	196

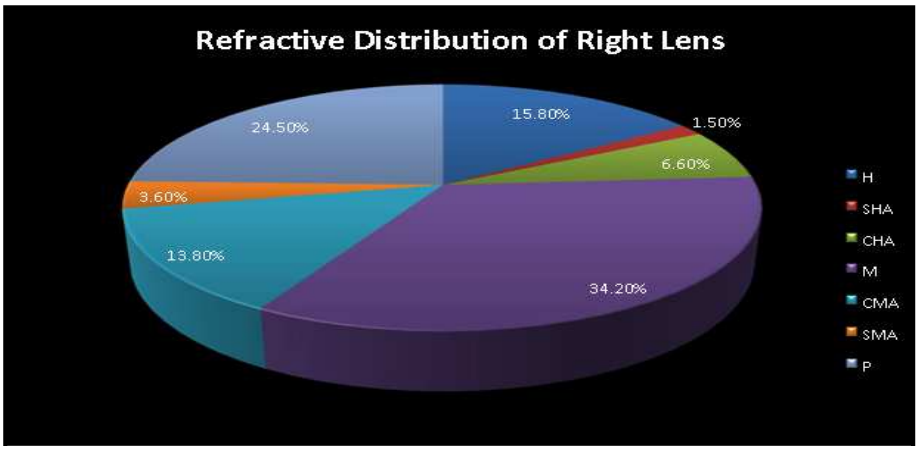

Figure No.1: Refractive distribution of right lens

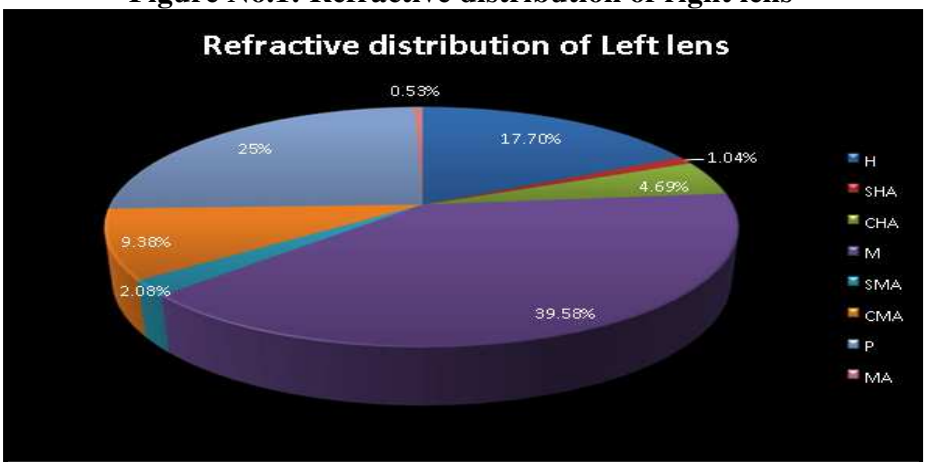

Figure No.2: Refractive distribution of left lens

ABBREVIATIONS

ANSI: American National Standard Institution
BI: Base In
BO: Base Out
CHA: Compound Hyperopic Astigmatism
CMA: Compound Myopic Astigmatism
HPE: Horizontal Prismatic Effect
IPD: Inter Pupillary Distance

MA: Mixed Astigmatism
OCD: Optical Center Distance
P: Presbyopia
PAL: Progressive Addition Lenses
PL: Plano lens
SH: Simple Hyperopia
SHA: Simple Hyperopic Astigmatism
SM: Simple Myopia
SMA: Simple Myopic Astigmatism
SPSS: Statistical Package for Social Science

CONCLUSION

In the present study, different parameters of a lens were assessed for their accuracy. The most inaccurately dispensed parameter was IPD which was followed by power and axis error accounting for closer values. IPD was not measured and written on the prescription by the practitioners and further it was overlooked by dispensers too, which indicates the professional negligence and/or professional incompetency. Generally, 67.38% of the spectacles had an error in at least one parameter. This shows that spectacles are being dispensed inaccurately in the dispensing facilities available in Asmara. This signifies the need for improvement in dispensing practice. Verifying the spectacles after they are prepared can be deemed as a solution to reduce problems related to spectacles.

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CONFLICT OF INTEREST

We declare that we have no conflict of interest.

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