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ORIGINAL ARTICLE

Amplitude of Accommodation and Its Relationship with Refractive Errors

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ABSTRACT

Presbyopia, the common condition of age-related vision condition which leads to difficulty in focusing on nearby objects because of alterations in the lenses of eyes. Its effect differs from emmetropic to hypermetropic persons.The present study aimed to compare between patients with fluctuating eyes and patients with fluctuating eyes when reaching (40) years of age. In this descriptive study, 80 persons with presbyopia whose ages were >35 years were enrolled. From each participant, demographic data were obtained including sex, age, occupations, educational levels as well as medical history and results of eye examination. For clinical examinations we used Snellen charts, retinoscopy, trial cases, auto-refractor as well as proximal charts for data collection. In the present study, we focused on the visual acuity variation and requirement through various demographics. In addition we focused on sex, age with the dynamic of accommodative amplitudes in relations to different types of refractions. Data obtained from (80) participants showed an evenly distribution of males and females, with a remarkable decline in accommodative amplitudes when age increased, and this decline was predominantly significant in the oldest group (70-79) years, who exhibited the lowest amplitude level. Moreover, our study investigated the association between accommodative amplitudes and refraction type and showed that emmetropia mostly happens at the lowest amplitudes, while myopia and hypermetropia were more predominant at the highest amplitudes. The main finding in the study was the direct relationship between declined accommodative amplitudes and increased dependence on near vision corrections, as shown by the highest diopter additions necessary for individuals with diminished amplitudes. This study's results demonstrated the ages and refractive trait's effects on accommodative capabilities and consequent needs for tailored corrective strategy.

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1- INTRODUCTION

The common age-related vision's condition known as presbyopia leads to gradual losses in the capacity of eyes to focus on nearby things. Around the (40) years of age presbyopia commonly developed and advanced as age increased [6]. For setting efficient treatments and managements plans, it is necessary that we recognize basic mechanism of presbyopia and its impacts on different refractive error groups such as emmetropic and hypermetropic patients. The main reason for presbyopia is the ages-related changing in crystalline lenses & structures which are surrounding it, that cause lowered accommodations and difficulties in near vision [1]. The actual reasons for presbyopia are multifactorial, involving both the structural & functional changes of eye [2]. It was shown by different studies the involvement of lens elasticity losses, lens thickenings as well as deficiency of lowered ciliary muscle in the progression &onset of presbyopia [11].

Emmetropic patients with typical refractive conditions and have ability to focusing on distant object without any correction, may also develop presbyopia with age advancement. Nonetheless, the effect of presbyopia possibly differs between patients suffering from emmetropia and patients suffering from hypermetropia [3]. On the other hand, patients with hypermetropes can hardly focus on nearby things even prior to the onsets of presbyopia owing to their refractive errors. Hence, presbyopia's effect on hypermetropic patients may be more noticeable than in emmetropic patients [4]. To optimize the strategies of presbyopia management, it is important to understand such variations tailored to the specific requirement for each group of patients. Despite the availability of corrective method options e.g. multifocal contact lens, reading glass and surgically techniques e.g. monovisions or multifocal intraoculars lense, their suitability and effectiveness may differ according to the status of refractive errors and the characteristics of patients [5].

The current study aimed to investigate and compare presbyopia's progression in individuals with emmetropic and hypermetropic eyes when they reach (40) years of age. Through exploring the variations in accommodative amplitudes, clinical features and methods of responding to treatments, we search for enhancing our understanding of presbyopia and improve its managements for various groups of refractive errors [6].

2- MATERIALS AND METHODS

The time limit for conducting this study was from 1/1/2024 to 1/4/2024. Data collection; Based on the questionnaire, all demographic data of the patients were obtained. The most important of these data were age, gender, profession, and educational level. Some private medical information was taken, including the medical history of eye and physical diseases, in addition to the results of the eye examination. Many devices and techniques have been relied upon for the purpose of eye examination, such as; retinoscopy It involves directing a light beam into the eye, analyzing the retinal reflex, and adjusting lenses for accurate measuring.A near chart, also known as a reading chart, is an primary tool for evaluating close-distance vision [12]. It consists of rows of characters of variable sizes to assess near vision acuity crucial for tasks same reading and A trial case is essential in optometry and ophthalmology, facilitating subjective refraction tests to prescribe corrective lenses. It houses interchangeable lenses, enabling customized combinations to correct refractive errors like myopia and hyperopia [8].

Statistical Analysis.

In analyzing the data, we relied on descriptive analysis to calculate frequencies and percentages and measured the relationship between variables, and we relied on the statistical program SPSS to complete the statistics process.

3- RESULTS

Table (1): showed that the study included an equal distribution of 80 participants between males and females, with a significant focus on middle-aged adults (ages 40-49), this age groups more active with close work.

Table (1): Distribution of Study Samples According to Age Group and Gender

Age groups / years	Gender		Total
	Male	Female	
40-49	20 (25%)	18 (22.5%)	38 (47.5%)
50-59	12 (15%)	12 (15%)	24 (30%)
60-69	8 (10%)	9 (11.2%)	17 (21.2%)
70-79	0 (0.0%)	1 (1.3%)	1 (1.3%)
Total	40 (50%)	40 (50%)	80 (100%)

Table (2): shows that this amplitude varies widely in (40-49) ages brackets but narrows significantly as age increases, with those aged (70-79) showing minimal amplitudes. Presbyopia usually becomes noticeable in your early to mid-40s and continues to worsen until age 70-75.

Table (2): shows the Relationship between Age groups and Accommodative Amplitude (AA)

Age groups	Accommodative amplitude					Total
	(2-4) D	(5-7) D	(8-10) D	(11-13)D	(14-16)D	
40-49	12 (15.0%)	16 (20.0%)	6 (7.5%)	2 (2.5%)	2 (2.5%)	38 (47.5%)
50-59	9 (11.2%)	7 (8.8%)	5 (6.2%)	2 (2.5%)	1 (1.3%)	24 (30%)
60-69	4 (5.0%)	7 (8.8%)	2 (2.5%)	2 (2.5%)	2 (2.5%)	17(21.2%)
70-79	0 (0.0%)	1 (1.3%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1(1.3%)
Total	25 (31.3%)	31(38.8%)	13 (16.3%)	6 (7.5%)	5 (6.2%)	80 (100%)

Table (3): shows highest amplitude of accommodation was observed in emmetropic state and followed by hypermetropia and myopia the observed differences in adaptation of tonic accommodation among refractive groups may be related to variations in autonomic innervation of the ciliary muscle.

Table (3): shows the Relationship between the Accommodative Amplitude (AA) and Type of Refraction

Accommodative amplitude	Type of refraction			Total
	Emmetropia	Hypermetropia	Myopia	
2-4 D	11 (13.7%)	8 (10%)	6 (7.5%)	25 (31.2%)
5-7 D	13 (16.3%)	11 (13.8%)	7 (8.8%)	31 (38.8%)
8-10 D	2 (2.5%)	7 (8.8%)	4 (5.0%)	13 (16.3%)
11-13 D	4 (5.0%)	1 (1.3%)	1 (1.3%)	6 (7.5%)
14-16 D	0(0.0%)	2 (2.5%)	3 (3.8%)	5 (6.2%)
Total	30 (37.5%)	29 (36.2%)	21 (26.3%)	80 (100%)

Table (4): shows decreasing in addition for near point with increasing the levels of accommodative amplitude lens becomes less flexible, it can no longer change shape to focus on close-up images. As a result, these images appear out of focus.

Table (4): The Relationship between the Accommodative Amplitude (A.A) and Addition of Near Point (NP) In Diopter

Accommodative amplitude	Addition of near vision				Total
	No needed	(+0.75)-(+1.25) D	(+1.50)-(+2.00) D	(+2.25)-(+3.0) D	
2-4 D	12(15%)	5(6.3%)	3 (3.8%)	5 (6.3%)	25(31.2%)
5-7 D	14(17.5%)	6(7.5%)	5 (6.3%)	6 (7.5%)	31(38.8%)
8-10 D	3(3.8%)	6(7.5%)	3 (3.8%)	1 (1.3%)	13(16.3%)
11-13 D	4(5.0%)	2(2.5%)	0 (0.0%)	0 (0.0%)	6(7.5%)
14-16 D	0(0.0%)	1(1.3%)	1 (1.3%)	3 (3.8%)	5(6.3%)
Total	33(41.3%)	20(25%)	12(15%)	15(18.8%)	80(100%)

4-DISCUSSION

In Table (1) the results shown the study included an equal distribution of 80 participants between males and females, with a significant focus on middle-aged adults (ages 40-49).The results shown in Table (2) highest amplitude of accommodation was observed in emmetropic state and followed by hypermetropia and myopia [10]. While Table (3) showed this amplitude varies widely in the 40-49 age bracket but narrows significantly as age increases, with those aged 70-79 showing minimal amplitudes [15]. Table (4) showed decreasing in addition for near point with increasing the levels of accommodative amplitude [14]. Moreover, a direct correlation is observed between decreased accommodative amplitude and increased dependence on near vision correction, evident from the higher diopter additions needed for lower amplitudes [13].The amplitude of accommodation plotted against ocular refraction and demonstrates that differences in amplitude of accommodation occur with respect to refraction. However, the relationship is nonlinear, with low myopes exhibiting the largest clinical amplitude of accommodation[9].The onset of presbyopia depends not only on age but also on refraction of the individual and his/her reading habits. A hypermetrope starts in life with a near point cosiderabely farther away than that of an emmetrope, therefore patients may show presbyopic symptoms at the age of 25 years. In myopes, opposite statement ours showed. Although a number of studies have been done on presbyopia and amplitude of accommodation separately, we found only one study measurement the amplitude of accommodation in the peri-presbyopic age [7].

5-CONCLUSION

The study included an equal distribution of 80 participants between males and females, with a significant focus on middle-aged adults (ages 40-49).The study that means amplitude of accommodation gradually decreased with increasing age. Highest amplitude of accommodation was observed in emmetropic state and followed by hypermetropia and myopia. Decreasing in addition for near point was showed with increasing the levels of accommodative amplitude. (the ability of eyes for focusing from a distant to near object).The amplitude of accommodation is generally higher in myopes in all age groups as compared to hypermetropes and emmetropes and they usually develope presbyopic symtoms later in life.

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