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***Original Article***

# Study of the Amplitude of Accommodation and its Relation to Errors of Refraction: Hospital Based Study

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**Abstract**

**Bakground**

The unique ability of the eye to vary the refractive power of the lens and to focus on things at a range of distances is called accommodation. The reduction of this ability in which the near point recedes further away from comfortable reading distance is called presbyopia. There is continuing research to understand this process and correct this affliction that affects each and every person at the peak of their productive life. With an aging population, the proportion of people above 40 years is on the rise. This will therefore have public health and economic implications.

**Materials and Methods**

This is a hospital based retrospective study which was conducted in 100 presbyopic patients in age group of 35 to 60 years at outpatient department of ophthalmology in Nobel Medical College and Teaching Hospital, Biratnagar, from 1st October 2016 to 30th March 2017. The amplitude of accommodation was calculated by measuring near point of accommodation with the help of RAF rule and the data collected was subjected to statistical analysis.

**Results**

Out of 100 patients in this study who visited our OPD with presbyopic complains, the no. of hypermetropic patients were highest (56%) and they presented with presbyopic symptoms at an early age as compared to myopes, while the no. of myopic patients were less(13%) and they presented late with presbyopic symptoms. The mean amplitude of accommodation was highest in myopes in all age group(3.35 D in 36-40 year age group which reduced to 2.65 D in 56-60 year age group).There was stastistically significant difference in amplitude of accommodation between myopia and hypermetropia in all age groups except in 56-60 year age group.

**Conlusion**

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.

***Key words:*** *Amplitude of Accommodation, presbyopia, Refractive error*

**Introdction**

Accommodation is the ability of the eyes to change refractive power of the lens and focus objects at various distances. It is a complex constellation of sensory, neuromuscular, and biophysical

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phenomenon by which overall refractive power of the eye changes at various distances to focus objects clearly on retina [1]. The factors that cause presbyopia are still unclear [2].
The point at which accommodation is maximally exerted is called the near point. Amplitude of accommodation (AA) is the amount of accommodation exerted to move the focus from the far point to the near point. It decreases from childhood to 65 years [3]. Clinically, amplitude of accommodation is the reciprocal of near point of accommodation (NPA), the later is measured with RAF rule [4].
Presbyopia is defined as the reduction in the range of accommodation or accommodative power which occurs with ageing .The definition of presbyopia is fluid because there is no standard distance for near work [5] . Symptoms of presbyopia itself can be dependent on other factors like amount of near work done, lighting conditions, corrected distance acuity etc [6].
In this study, we have planned to study accommodative process in peripresbyopic age since there is little data on the actual differences in accommodation that is preserved in various types of refractive errors.

**Materials and Methods**

This was a hospital based retrospective study on the patients with presbyopic symptoms who visited the outpatient department of ophthalmology in nobel medical college and teaching hospital from 1st october 2016 to 30th march 2017.
Patients between 35-60 yrs of age with clear ocular media and visual acuity improving to 6/6 on snellen's chart was included in the study. patients of Age <35 yrs of age and >60 yrs were excluded in the study. patients with hazy ocular media including corneal opacity and cataract> grade NO1, NC1,C1, P1 according to LOCS III cataract classification were also excluded. Also, patients with Spherical correction of more than 6.0 D and Cylindrical correction of more than 0.75 D were not included. Lastly, Patients of strabismus or with history of diabetes mellitus, systemic illness, trauma, drug therapy were also excluded.
Emmetropia, was defined as a spherical correction less than or equal to +/- 0.25 D after undilated retinoscopy and subjective refraction.
Hypermetropia was defined as spherical correction of more than or equal to + 0.50 D. Myopia was defined as a spherical correction of more than or equal to – 0.50D. The completed age in years was taken for age determination.The best corrected visual acuity was obtained after undilated retinoscopy and subjective refraction.
To quantify presbyopia, amplitude of accommodation was taken as a measure of accommodative reserve, which was measured with the RAF rule with full distance correction placed in the trial frame at a constant back vertex distance of 15mm. The NPA was measured with the patient trying to read the smallest letter (N5) on the RAF target rule. With the RAF rule in place the target was moved from 50 cm to the point where the last line became slightly blurred. Then the target was slowly pushed back till the last line was just clearly read. This point was taken as near point of accommodation (NPA)
The data collected was tabulated and results of study were analyzed using statistical package for social science (SPSS) 16.0 and Microsoft Word and Microsoft Excel have been used to generate graphs, tables, etc. Significance level was assessed by calculating 'p' value using student T test. Observations were taken as significant at 'p' value less than 0.05 ('p' <0.05).

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**Results**

Out of 100 patients in our study, 50 were male and 50 were female. There were 56 hypermetropic, 13 myopic and 31 emmetropic patients. Table 1 gives the distribution of number of eyes studied according to age group and refractive errors. The mean amplitude of accommodation along with their standard deviation for different age groups and refractive errors are shown in table 2 to table 6 respectively. There was stastistically significant difference between myopes and hypermeropes in 35 to 40 years age group ($p = 0.02$, standard error (SE) = 0.26**)**. Statistically significant differences was found among amplitude of accommodation of hypermetropes and myopes ($p = 0.01$, $SE = 0.46$) and also between myopes and emmetropes ($p = 0.03$, $SE = 0.23$) in patients of age group 41 to 45 years. Similarly, in age group of 46-50 years, statistical analysis showed significant difference between amplitude of accommodation of myopes and hypermetropes ($p = 0.02$, $SE = 0.36$) and between myopes and emmetropes($p = 0.01$, $SE = 0.40$). Lastly, in age group of 56 to 60 years, stastistical evaluation showed no stastistically significant relationship between the three refractive error groups ($p = 0.6$ for hypermetropia and myopia; $p = 0.65$ for myopia and emmetropia).

**Table 1: Refractive Status of the Presbyopic patients**

| AGE GROUPS (YRS) | REFRACTIVE STATUS OF THE PATIENTS | | | | | | TOTAL |
|---|---|---|---|---|---|---|---|
| | MYOPIA | | EMMETROPIA | | HYPERMETROPIA | | |
| | NO. OF CASES | % | NO. OF CASES | % | NO. OF CASES | % | |
| 36-40 | 03 | 11% | 10 | 37% | 14 | 51% | 27 |
| 41-45 | 03 | 13% | 14 | 42% | 16 | 48% | 33 |
| 46-50 | 02 | 11% | 04 | 23% | 11 | 64% | 17 |
| 51-55 | 03 | 23% | 02 | 15% | 08 | 61% | 13 |
| 56-60 | 02 | 20% | 01 | 10% | 07 | 70% | 10 |

**Table 2: Amplitude of accommodation (AOA) in 36-40 year age group**

| NO OF CASES | MYOPIA | HYPERMETROPIA | EMMETROPIA |
|---|---|---|---|
| | 03 | 14 | 10 |
| Mean AOA | 3.35 | 2.93 | 3.13 |
| S.D | 0.32 | 0.41 | 0.33 |

**Table 3: amplitude of accommodation in 41-45 year age group**

| NO. OF CASES | MYOPIA | HYPERMETROPIA | EMMETROPIA |
|---|---|---|---|
| | 03 | 16 | 14 |
| MEAN AOA | 3.16 | 2.82 | 3.80 |
| S. D. | 0.46 | 0.36 | 0.27 |

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**Table 4: Amplitude of accommodation in 46-50 year age group**

| NO OF CASES | MYOPIA | HYPERMETROPIA | EMMETROPIA |
|---|---|---|---|
| | 02 | 11 | 04 |
| MEAN AOA | 3.15 | 2.29 | 2.23 |

**Table 5: Amplitude of accommodation in 51-55 year age group**

| NO OF CASES | MYOPIA | HYPERMETROPIA | EMMETROPIA |
|---|---|---|---|
| | 03 | 08 | 02 |
| MEAN AOA | 2.57 | 2.09 | 2.00 |
| S.D. | 0.29 | 0.25 | 0.0 |

**Table 6: Amplitude of accommodation in 56-60 year age group**

| NO. OF CASES | MYOPIA | HYPERMETROPIA | EMMETROPIA |
|---|---|---|---|
| | 02 | 07 | 01 |
| MEAN AOA | 2.65 | 2.09 | 2.00 |
| S.D. | 0.15 | O.23 | 0.00 |

**Discussion**

The effect of age on the amplitude of accommodation and the onset of presbyopic symptoms is a well known fact. 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 condition ours. Although a number of studies have been done on presbyopia and amplitude of accommodation separately, we found only one study measuring the amplitude of accommodation in the peri-presbyopic age [7].

In our study, we found that the total number of hypermetropes was highest (56%) and the total no of myopes was lowest (13%). These findings correlated with the study 'Human eye as an optical system' which showed that myopes seek help for presbyopic symptoms much later than the rest[8]. It could be due to the fact that these individuals remove their glasses for near work. Another study concluded that corrected hypermetropes will need near addition at a younger age due to lower effective accommodation and hypermetropes are symptomatic earlier than myopes[7], this observation is in correlation with our study. Also, they found that the amplitude of accommodation is highest in myopes and lowest in hypermetropes till the age of 44 years. The amplitude of accommodation in emmetropes is in between the two extremes, though in their study in the 35 to 40 yrs age group the amplitude of accommodation was highest in emmetropes but they could not find the stastically significant difference in their study due to small number of hypermetropes in this age group. However, they did not find any stastistical significant difference in amplitude of accommodation in the three refractive error groups after the age of 44 yrs, which is in contrast to this study where we found stastistically significant difference in amplitude of accommodation between the three refractive groups until the age of 55 yrs. This could probably be due to the fact that they studied large number of cases and our

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sample size was small and probably due to small number of hypermetropes presenting to us in 56-60 year age group. Our observation regarding amplitude of accommodation correlates well with another study which showed that difference in amplitude of accommodation occurs with respect to refraction and the relationship is non linear with low myopes exhibiting the largest clinical amplitude of accommodation[9]. However, we found one study which showed that the refractive errors do not affect the dynamics of natural accommodation[10].

## Conclusion

In conclusion, we can say that the amplitude of accommodation is generally higher in myopes in all age groups as compared to hypermetropes and emmetropes. This is probably why myopes develop presbyopic symtoms later in life.

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