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A Study on Amplitude of Accommodation in Different Refractive Condition in Bengali Population

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Abstract: *Accommodation is a dynamic change in the dioptric power of the eye. The mechanism of accommodation has been studied for at least 400 years. But how the amplitude of accommodation varies with different refractive status (emmetropia / myopia / hypermetropia) is not much studied so far. So we conducted this study comprising of 600 eyes belonging to 300 healthy Bengali people of different age group of either sex in a tertiary level hospital, for a period of one year. After a routine ophthalmic examination and full distance correction, the near point of accommodation was measured, one eye at a time, using RAF rule by Duane's method. Observation led us to conclude that highest amplitude of accommodation was observed in myopes followed by emmetropes and hypermetropes. Although the gradual and steady decrease in amplitude of accommodation with age was similarly marked, irrespective of different refractive condition.*

Keywords: *Amplitude of accommodation, Emmetropia, Hypermetropia, Myopia, Refractive condition.*

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I. Introduction

Accommodation is a dynamic change in the dioptric power of the eye.[1] The mechanism of accommodation has been studied for at least four hundred years. It is a complex constellation of sensory, neuromuscular and biophysical phenomena by which the overall refracting power of the eye changes rapidly to image objects at different viewing distances clearly on to the retina.[2] The most interesting aspect of accommodation is that its time course is well in advance of other physiological functions – it begins to decline by adolescence and is lost about two-thirds of the way through the normal life span. The state of presbyopia is reached when accommodation has declined sufficiently to interfere with close tasks requiring acute vision either due to change in physiology of the lens and its capsule or within their support structures.[3] The point at which accommodation is maximally exerted is called the Near Point of Accommodation (NPA). 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.[4] But how it varies with different refractive status (emmetropia / myopia / hypermetropia) of the eye is not much studied so far. This work will try to find out the AA in different refractive condition of the eye.

II. Materials And Methods

The cross-sectional, tertiary care institution based study was conducted at Institute of Post Graduate Medical Education and Research (IPGME&R), Kolkata over the period of 1 year (April 2007- March 2008) in the patients who attended the out-patient department of Ophthalmology. Altogether 300 participants were selected by systematic random sampling method as per the inclusion and exclusion criteria.

2.1 Inclusion Criteria

Patient, who voluntarily gave written consent to be the part of the study, was included. One person was interrogated single time.

2.2 Exclusion Criteria

i. Spherical corrections of more than 6.00 Dsph (Dioptre Sphere) of hypermetropia or myopia and cylindrical correction of more than 0.75 Dcyl (Dioptre Cylinder).
ii. History of diabetes mellitus or any thyroid disease.
iii. Ocular Pathology (cataract trauma, glaucoma, retinal photocoagulation and uveitis).
iv. History of ocular surgery (LASIK, cataract surgery glaucoma surgery).

An emmetropic eye was defined as an eye having spherical correction ≤±0.25 dioptre, in undilated retinoscopy and subjective refraction. Hypermetropia was considered if any eye with a spherical correction ≥+0.50 dioptre. Myopic eyes were those with a spherical correction of ≥-0.50 dioptre.

A routine ophthalmic examination was done for all patients. Ametropic cases were given full distance correction before recording the NPA with a trial frame placed 15 mm in front of the eye. The NPA was measured, one eye at a time, using an RAF (Royal Air Force)-Rule by Duane's method, gradually bringing the object closure and closure to the eye until it reached the position where the fixation object begins to become indistinct (clear to blur method).

The NPA was measured with the patient trying to read the smallest letter (N5) on the RAF-Rule target. 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. Since the RAF near point rule is only 50 cm long in presbiopic cases where the NPA was more than 50 cm, a +1.00 D spherical lens was added to the trial frame and the near point measured again. The actual NPA was calculated mathematically from this value. Reciprocal of the NPA in meters is the AA. Data were collected, codified in excel spread sheet and analyzed with appropriate statistical method by using Statistical software.

III. Result And Analysis

Table-1: Distribution of participants according to Age and Gender

Age group (years)	No. of male	No. of female	Total
≤10	4	2	6
11-20	10	5	15
21-30	22	10	32
31-40	36	40	76
41-50	34	31	65
51-60	22	39	61
>60	20	25	45
Total	148 (49.33%)	152 (50.67%)	300

There was no gender predominance seen in the study group.

Table-2: Distribution of various types of refractive errors (in individual eyes) in different age groups

Age group (years)	Emmetropes (% within groups)	Myopes (% within groups)	Hypermetropes (% within groups)	Total
≤10	0 (0.0%)	6 (50.0%)	6 (50.0%)	12
11-20	8 (26.7%)	10 (33.3%)	12 (40.0%)	30
21-30	20 (31.3%)	30 (46.9%)	14 (21.8%)	64
31-40	68 (44.7%)	52 (34.2%)	32 (21.1%)	152
41-50	52 (40.0%)	36 (27.7%)	42 (32.3%)	130
51-60	40 (32.8%)	52 (42.6%)	30 (24.6%)	122
>60	30 (33.3%)	28 (31.1%)	32 (35.6%)	90
Total	218 (36.3%)	214 (35.7%)	168 (28.0%)	600

Table-3: Mean amplitude of accommodation in dioptre in different age group

Age Groups (years)	No. of Eyes examined	Mean amplitude of accommodation in dioptre in both eyes
≤10	12 (2.0%)	14.9
11-15	16 (2.6%)	9.5
16-20	14 (2.3%)	8.2
21-25	10 (1.6%)	7.7
26-30	54 (9.0%)	6.4
31-35	24 (4.0%)	5.1
36-40	128 (21.3%)	3.9
41-45	98 (16.3%)	2.8
46-50	32 (5.3%)	2.5
51-55	64 (10.6%)	2.1
56-60	58 (9.6%)	1.8
61-65	58 (9.6%)	0.9
66-70	20 (3.32%)	0.6
>70	12 (1.99%)	0.4

Data revealed that mean AA was gradually and steadily decreased with increasing age.

Table-4: Mean amplitude of accommodation in relation to sexes of different Age groups

Age group (years)	AA in Male (dioptre)	AA in Female (dioptre)
≤10	14.6	14.3
11-20	9.1	8.7
21-30	6.8	6
31-40	4.9	4.2
41-50	3.9	3.1
51-60	2.6	2.0
>60	0.7	0.4

Table 5: Mean amplitude of accommodation in different age groups and refractive errors

Age (years)	Emmetropes (Mean AA in dioptre)	Myopes (Mean AA in dioptre)	Hypermetropes (Mean AA in dioptre)
≤10	No data	15.2	14.1
11-20	10.1	11.4	9.1
21-30	8.1	8.7	6.1
31-40	4.1	4.9	3.5
41-50	2.8	3.2	2.4
51-60	2.3	2.7	2.0
>60	1.4	1.9	0.9

IV. Discussion

In the present study, AA in different refractive status of eye was carried out in 600 eyes belonging to 300 healthy Bengali people of different age group of either sex and revealed that mean AA was gradually and steadily decreased with increasing age (Table- 3), which was supported by Denders et al. (1864) who studied the accommodation in normal healthy subjects of different age groups and had shown that with the increase of age, the power of accommodation diminishes from 14.0 D (at the age of 10 years) to 0 D (at the age of 70 years). The result was also supported by Duane et al.[5] and Duke et al.[6] But Dhir et al. found no difference while comparing the result of his study, conducted on 500 Indian subjects.[7]

In present study it was obvious that decline of accommodation occurred more rapidly in females when compared to age matched males (Table- 4), which were supported by Slataper (1950). This may be the reason that women are more likely to develop presbyopia earlier.[8] It is also possible that hormonal influences may play a role in the onset of presbyopia but our study was not designed to explore this possibility.

Present study showed highest amplitude of accommodation in myopes followed by emmetropes and hypermetropes; although the gradual and steady decrease in accommodation with age is similarly marked in different refractive status of the eye (Table- 5). So the presbiopic corrections are required earlier in hypermetropes than myopes. Lekha et al. had shown higher AA among myopes between 35- 44 years, compared to emmetropes and hypermetropes[9], which supported our findings. Werner et al. had mentioned that presbiopia in emmetropes and hyperopes usually manifested at the age of 40 years. Normal myopes were found to be benefited at this age because of their shortsightedness but their accommodative amplitude also diminished with age.[10]

V. Conclusion

It could be concluded from the present study that mean amplitude of accommodation gradually and steadily decreased with increasing age and decline of accommodation occurs more rapidly in female subjects when compared to age matched male. Highest amplitude of accommodation was observed in myopes followed by emmetropes and hypermetropes. Gradual and steady decrease in accommodation with age was similarly marked in different refractive status of the eye.

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