

Accommodative Insufficiency in Prepresbyopic Diabetic Patients

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Abstract: Diabetes mellitus is a clinical syndrome characterized by a defect in the glucose metabolism due to the decrease in the secretion of insulin or due to insulin resistance. The complications of diabetes mellitus in the eyes include many manifestations and one among them is the reduction of accommodative amplitude. People with diabetes have accelerated age-related biometric ocular changes compared with people without diabetes. This purpose of this study is to compare the accommodative amplitude in prepresbyopic diabetic patients with age related healthy individuals. The study was a case control hospital based study carried out in the Department of Ophthalmology, Saveetha Medical College. The subjects in the study included 50 diabetic patients of age 30 to 40 (Case) and 50 non diabetic patients of the same age (control). The accommodative amplitude was measured by minus lens method. People who have had diabetic retinopathy, previous ocular surgeries and systemic diseases which have more ocular manifestations were excluded. The mean amplitude of accommodation is seen to be lower in diabetic patients when compared with the normal population and it was found to be statistically significant. The incidence of accommodation insufficiency was also found to be higher in diabetic patients and was found to be statistically significant. Thus according to the findings there is a direct influence of diabetes on accommodative amplitude i.e, there is a decrease in accommodative amplitude in diabetic patients when compared with normal patients.

Keywords: Diabetes; Accommodative insufficiency; Accommodative amplitude; Presbyopia; Minus lens method

1. Introduction

Diabetes mellitus is a rapidly emerging disease in the growing world. Diabetes mellitus is a clinical syndrome characterized by a defect in the glucose metabolism due to the decrease in the secretion of insulin or due to the defective action of it. Worldwide, diabetes continues to be a costly disease with a great healthcare impact due to its increased prevalence and high mortality and morbidity rate. (Solani David Mathebula, Prisilla Seipati Makunyane, 2017) The complications of diabetes mellitus may include manifestations in the eyes, nerves and kidneys. In the eyes it has a number of manifestations but most importantly will result in retinopathy and cataract. It affects the biometry and optics of the eye. Blurring of vision is the first sign of diabetes mellitus affecting the eye. There has been an established connection between diabetes and accommodation of the eye.

Accommodation can be defined as the increase in the refractive power of the eye for focusing near objects of regard on the retina (Atchison DA et al., 1994). Accommodation can be also defined as the eye's mechanism by which it adjusts its power to focus on objects at different distances (Tunnacliffe AH et al., 2001). The maximum accommodation that can be exerted is accommodative amplitude. There are many types of methods for the measurement of accommodative amplitude such as Donder's push up method, Shread's minus lens method, push down method and modified push up method. In this study, the accommodative amplitude was measured by minus lens method. Presbyopia usually occurs after 40 years of age. Presbyopia is a disorder which causes reduction in the amplitude of accommodation due to loss of elasticity of fibers. People below the age of 40 usually have no problem

with accommodation but there is an established association between decrease in accommodation amplitude and diabetes. In this study the accommodative insufficiency in prepresbyopic patients with diabetes is measured to show the prevalence of accommodative insufficiency in prepresbyopic diabetic patients and the amplitude of accommodation between diabetic and normal individuals is compared.

2. Materials and Methods

The study was a case control hospital based study carried out in the Department of Ophthalmology, Saveetha Medical College. The subjects in the study included 50 diabetic patients of age 30 to 40 (Case) and 50 non diabetic patients of the same age (control). The inclusion criteria for the diabetic group includes patients age should be between 30 to 40 and not affected by diabetic retinopathy and HbA1c less than 7. The Exclusion criteria include presence of diabetic retinopathy, previous ocular surgeries and systemic diseases which have more ocular manifestations. Demographic data including age, gender, socioeconomic status and address were recorded. Then the patient was given reduced Snellen chart at 40 cm. The subjects were asked to fixate on the 20/20 row on the chart, while a minus power was added (in 0.25 D steps) to the previously-determined subjective refraction until the letters became, and remained, blurred. The minus lens amplitude was taken as the amount of minus lens power + 2.50 D as it taken as the dioptric equivalent of the working distance.

3. Results

Comparison of Gender and Diabetic status with respect to Amplitude of Accommodation: To compare the gender and the diabetic status with regard to Amplitude of

Accommodation, independent samples t-test is employed. The results are shown in the following Table.

Null hypothesis H₀1: There is no significant difference between the (a) gender (b) diabetic statuses with respect to the Amplitude of Accommodation

From the Table 1, the t-value **0.076** is insignificant at 5% level of significance, the null hypothesis **H₀1 (a)** is accepted. This shows that there is no significant difference between the genders with respect to Amplitude of Accommodation.

From the Table 1, the t-value **12.602** is significant at 1% level of significance, the null hypothesis **H₀1 (b)** is rejected. This shows that there is significant difference between the diabetic statuses with respect to Amplitude of Accommodation. Further the mean score of the patients with diabetic (**-3.73**) is lesser in Amplitude of Accommodation than the respondents without diabetics (**-4.84**) are having greater Amplitude of Accommodation.

Association of the Accommodative insufficiency with gender and diabetic status

To study the association between the Accommodative insufficiency with Gender and Diabetic status, Chi-square test for independence of attributes are used. The next two tables show the association of the Accommodative insufficiency with gender and diabetic status.

Null hypothesis H₀ 2: Accommodative insufficiency is independent of Gender

From the Table *2*, the Chi-square value of 1.148 is insignificant and the null hypothesis **H₀2** is accepted. It is concluded that Accommodative insufficiency is independent of Genders, i.e., the Accommodative insufficiency is not associated with Genders significantly.

Null hypothesis H₀3: Accommodative insufficiency is independent of Diabetic status

From the Table *3*, the Chi-square value of **53.386** is significant and the null hypothesis **H₀3** is rejected. It is concluded that Accommodative insufficiency is not independent of Diabetic status, i.e., the Accommodative insufficiency is associated with Diabetic status significantly. It is evident from the above Table that **93.8%** of the patients who are suffering from Diabetics have Accommodative insufficiency.

4. Discussion

The crystalline lens of the human being accounts for 20% of the total eye's refractive power (Rabbetts RB et al., 2007). Any alteration in the structure or morphology of the crystalline lens is associated with changes in the refractive status. Comparing the diabetic subjects with non-diabetic controls revealed the impact of diabetes on the amplitude of accommodation measurements.

In this research, there seems to be direct link between the increase in accommodative insufficiency and diabetes in a prepresbyopic population. In the research conducted by Solani David Mathebula & Prisillaseipati Makunyane (Solani David Mathebula, Prisilla Seipati Makunyane,

2017), there is the same result where there is an increase in the accommodative insufficiency and there was also a decrease in the mean accommodative amplitude in diabetic patients when compared to age matched normal patients. This was also seen true in the above research article.

They are also agreeable with the research done by Pawelski and Gliem (Pawelski WJ et al., 1971). who did a comparison of accommodative amplitude between diabetic and non diabetic controls and they found that there is less accommodative amplitude in diabetic patients than in people who did not have diabetes. Moss et al (Moss et al., 1987) did a study on 61 subjects whose ages ranged from 9 to 16 years in diabetic versus normal controls. They found lower amplitude of accommodation in diabetic subjects. Our results were similar to the researches done by Pawelski and Gliem (Pawelski WJ et al., 1971), Solani David Mathebula & Prisillaseipati Makunyane (Solani David Mathebula, Prisilla Seipati Makunyane, 2017) and Moss et al (Moss et al., 1987).

The reduction in the amplitude of accommodation in diabetic patients is ambiguous but can be due to over-hydration or the continual growth of the lens fibers throughout life. The possible hypothesis to explain this could be that during the periods of hyperglycemia there is an excess accumulation of glucose in the crystalline lens, which is then converted to sorbitol by a certain enzyme, and further converted into fructose by the sorbitol dehydrogenase (Solani David Mathebula, Prisilla Seipati Makunyane, 2017)

5. Conclusion

Thus according to the findings there is a direct influence of diabetes on accommodative amplitude i.e, there is a decrease in accommodative amplitude in diabetic patients. The prevention of this complication depends on certain lifestyle changes and anti diabetic drugs which will help in keeping a stable low blood sugar level. Thus in this project it is clearly seen that uncontrolled diabetes causes presbyopia earlier than usual, so the people must maintain a stable low blood sugar level to prevent this complication. The other important inference here is that if a patient with complaints of blurry vision and is below 40 years of age comes to the OPD then diabetes should also be a valid diagnosis to consider. As for diabetic patients a constant care and checkup of eye for early detection of presbyopia and correcting it is recommended

References

- [1] Solani David Mathebula, Prisilla Seipati Makunyane, 2017. Amplitude of accommodation is reduced in prepresbyopic diabetic patients. Journal of endocrinology, Metabolism and diabetes of south Africa. 10.1080/16089677.2017.1316955
- [2] Atchison DA, Copper EJ, McCabe KL, 1994. Critical subjective measurement of amplitude of accommodation. Optom Vis Sci, 71(11):699–706.
- [3] Tunnaclyffe AH, 2001. Introduction to visual optics, London, England: The Association of British Dispensing Opticians.
- [4] Rabbetts RB, 2007. Bennett & Rabbett' clinical visual optics. 3rd ed. London: Butterworth-Heinemann.

- [5] Pawelski WJ, Gliem H, 1971. Untersuchungen über die Akkommodationsbreite bei Diabetikern. *Ophthalmologica*, 163(4):216–26.10.1159/000306647
- [6] Moss SE, Klein R, Klein B. E. K, 1987. Accommodative ability in younger-onset diabetes. *Arch Ophthalmol*, 105(4):508–12.10.1001/archophth.1987.010600400.

Table 1: Comparison of Gender and Diabetic status with respect to Amplitude of Accommodation

		N	Mean	SD	t-value
Gender	Male	44	-4.31	0.691	0.076
	Female	56	-4.32	0.721	P=.939
Diabetic status	yes	48	-3.73	0.452	12.602**
	No	52	-4.84	0.422	P=.000

**Significant at 1% level

Table 2: Accommodative insufficiency according to Gender

			Accommodative insufficiency		Total	Chi-square Value
			Yes	No		
Gender	Male	N	22	22	44	1.148 P=.248
		%	50.0%	50.0%	100.0%	
	Female	N	34	22	56	
		%	60.7%	39.3%	100.0%	
Total		N	56	44	100	
		%	56.0%	44.0%	100.0%	

Table 3: Accommodative insufficiency according to Diabetic status

			Accommodative insufficiency		Total	Chi-square Value
			Yes	No		
Diabetic status	Yes	N	45	3	48	53.386** P=.000
		%	93.8%	6.3%	100.0%	
	No	N	11	41	52	
		%	21.2%	78.8%	100.0%	
Total		N	56	44	100	
		%	56.0%	44.0%	100.0%	

**Significant at 1% level