

## A Study of Protective Role of Tigroid Fundus in the Development of Diabetic Retinopathy

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### Abstract

### Original Research Article

**Background:** Aim is to identify whether tigroid fundus modifies the incidence of retinopathy in diabetic patients and to assess whether it is a protective factor for diabetic retinopathy. **Methods:** This was a hospital based descriptive study. 100 each of tigroid and non tigroid who were 41 years and above having diabetes  $\geq 5$  years were included. All cases except those who had myopia  $> -0.5D$  were included. Visual acuity was recorded. Anterior and posterior segments were examined. Diabetes was labelled controlled if HbA1c was  $< 6.5\%$  and uncontrolled if  $> 6.5\%$ . **Results:** Among 100 patients of each group, 72% with tigroid fundus and 13% with non tigroid fundus had no DR. Among 115 patients of  $> 10$  years duration DR was high in non tigroid (38% tigroid and 98% non tigroid) when compared to those with duration  $\leq 10$  years (15.5% tigroid and 70% non tigroid). Also patients with duration  $\leq 10$  years, 84% tigroid fundus and 30% non tigroid fundus had no DR when compared to  $> 10$  years duration which were 61% tigroid fundus and 2% non tigroid fundus. Among patients with HbA1c  $\leq 6.5\%$ , 86% tigroid and 25% non tigroid has no DR. Also DR was more in non tigroid (74%) than in tigroid (13%). In patients with HbA1c  $> 6.5\%$ , 65% tigroid and 2% nontigroid has no DR. DR was more in non tigroid (98%) than in tigroid (34%). In each age group tigroid fundus has less DR compared to non tigroid fundus. **Conclusion:** Tigroid fundus was observed as a protective factor for DR and association of age, HbA1c and duration of diabetes for development of DR in both tigroid and non tigroid fundus was significant (p value  $< 0.001$ ).

**Keywords:** Diabetic retinopathy, Tigroid fundus, HbA1C.

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## INTRODUCTION

One of the leading causes of preventable blindness in the world is diabetic retinopathy. In poorly controlled diabetes, chronic hypoxia occurs as a result of biochemical alterations and altered hemodynamics of the retinal vasculature [1, 2]. Compensatory pathways such as up regulation of VEGF protein are targeted against this retinal hypoxia. All these result in pathological changes of DR; retinal capillary micro aneurysm, vascular permeability and eventual vascular occlusion or capillary closure.

Ischemia of inner retinal layers secondary to regional closure of the retinal capillary bed results in endothelial proliferation and neovascular formation in the retina [3-6]. Up regulation of genes such as hypoxia inducible factor and subsequent production of a variety of endothelial mitogens, most notably VEGF occurs due to retinal hypoxia. Also a variety of mitogenic cytokines are produced subsequent to a localized low grade inflammatory response within the vessels. This

produces a neovascular response locally and diffusing through the vitreous to other areas of the retina, to the optic disc and into the anterior chamber [7-9].

Tessellated or tigroid fundus are polygonal dark areas of choroid in between choroidal vessels due to retinal pigment epithelium atrophy and prominent choroid pigmentation [10]. These changes increase the oxygen supply and thereby prevent retinopathy by decreasing the metabolic need and clearing out the waste products from the diseased retina [11]. Factors that have been generally reported to cause the onset of diabetic retinopathy are duration of diabetes, poor control of diabetes as estimated by the glycosylated hemoglobin level, age of the patient, hypercholesterolemia, overweight, smoking, alcohol, renal failure and pregnancy. However there are local factors that prevent retinopathy in spite of the above mentioned risk factors. Our study revealed that tigroid fundus has a protective role in diabetic retinopathy [10].

## METHODS

This was a hospital based descriptive study. 200 diabetic patients, 100 each with tigroid and non tigroid fundus attending ophthalmology department who were 41 years and above having diabetes for 5 years and beyond were included in the study. The study was conducted after getting institutional ethics committee approval. Informed consent was taken from all patients. All cases in our study were emmetropic or hyperopic or mild myopic with  $<-0.5$  D spherical error to avoid role of myopia as a protective factor in diabetic retinopathy. Cases with glaucoma, optic neuropathy, optic atrophy and age related maculopathy; cases that had undergone any ocular surgeries or laser treatment, smokers and alcoholics, patients with hypertension, anaemia, renal failure, hypercholesterolemia and pregnant women were excluded. Visual acuity was recorded with snellen's chart. Anterior segment of all eyes were examined with slit lamp. Posterior segment of all eyes were examined with direct and indirect ophthalmoscope and +90D lens after dilatation with tropicamide 1% eye drops. Diabetes was labelled controlled if HbA1c  $<6.5\%$  and uncontrolled if  $>6.5\%$ . The variables for this study were age, duration of diabetes, HbA1C, tigroid and non tigroid fundus, NPDR, PDR and Advanced DR. Data storing and analysis was done using SPSS 16.

## RESULTS

A total of 200 diabetic patients, 100 each with tigroid and non tigroid fundus attending ophthalmology department were included in the study. They belonged to the age ranging from 41 to 80 years having diabetes for 5 years and above. 109 of whom were males (54.5%) and 91 were females (45.5%). 85 patients (42.5%) were with duration of diabetes  $\leq 10$  years while 115 were with  $>10$  years duration. 42 patients (21%) were in age 41-50 years, 54 patients (27%) in age group 51-60 years, 61 patients (30.5%) in age group 61-70 years and 43 patients (21.5%) in 71-80 years. Out of the 200 patients 85 patients (42.5%) had no DR, 73 (36.5%) had NPDR, 35 (17.5%) had PDR and 7 (3.5%) had advanced DR. Those with HbA1C  $\leq 6.5\%$  were 77 (38.5%) and with HbA1C  $>6.5\%$  were 123 (61.5%).

In our study, 72% with tigroid fundus and 13% with non tigroid fundus had no DR showing that DR was significantly low in tigroid fundus ( $p$  value  $<0.001$ ). Also tigroid fundus showed total absence of PDR and advanced DR revealing its protective role (FIG 1).

The number of patients with DR increased as the duration of diabetes increased. Out of the 85 patients with duration  $\leq 10$  years, 35 patients had DR (41.17%) and out of 115 patients with duration  $>10$  years, 80 patients (69.5%) had DR (69.5%) (FIG 2).

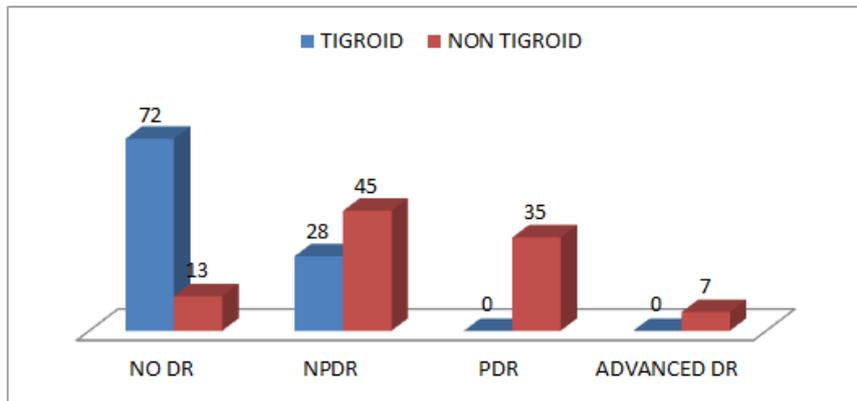
Among patients with duration of diabetes  $\leq 10$  years, incidence of DR was only 15.5% in tigroid fundi and 70% in non tigroid fundi.

Similarly among patients with duration of diabetes  $>10$  years, incidence of DR was only 38% in tigroid fundi and 98% in non tigroid fundi. This association was statistically significant ( $p$  value  $<0.001$ ) (FIG 3).

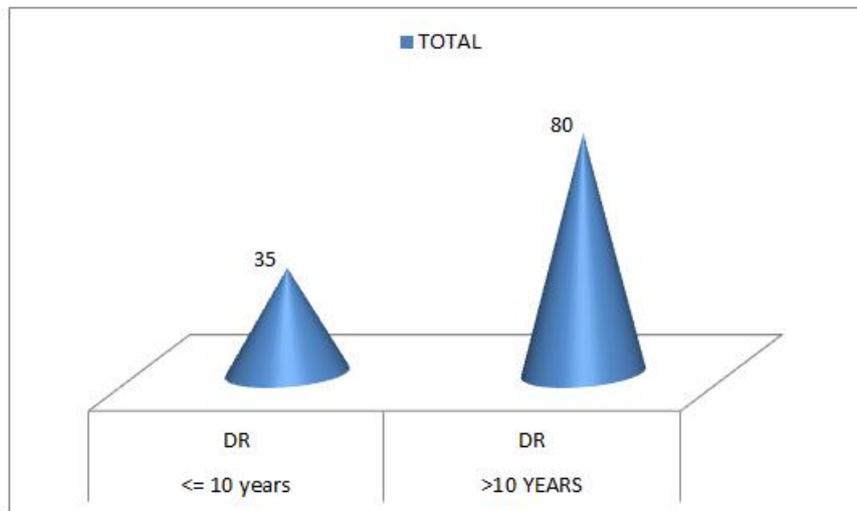
Among patients with HbA1C  $\leq 6.5\%$ , 86% with Tigroid fundus had no DR when compared to only 25% with non tigroid fundus. Similarly in patients with HbA1C  $>6.5\%$ , 65% tigroid fundus has no DR when compared to only 2% with non tigroid fundus (FIG 4).

DR was found to be higher in patients having glycosylated hemoglobin  $>6.5\%$ . Out of the 77 patients with HbA1C  $\leq 6.5\%$ , only 39 had DR (50.6%) whereas out of the 123 patients with HbA1C  $>6.5\%$ , 76 had DR (61.5%). DR was found to be higher in patients with non tigroid fundus which were 98% with HbA1C  $>6.5\%$  and 74% with HbA1C  $\leq 6.5\%$  when compared to those with tigroid fundus, which were 34% with HbA1C  $>6.5\%$  and 13% with HbA1C  $\leq 6.5\%$  showing statistical significance ( $p$  value  $<0.001$ ) (FIG 5).

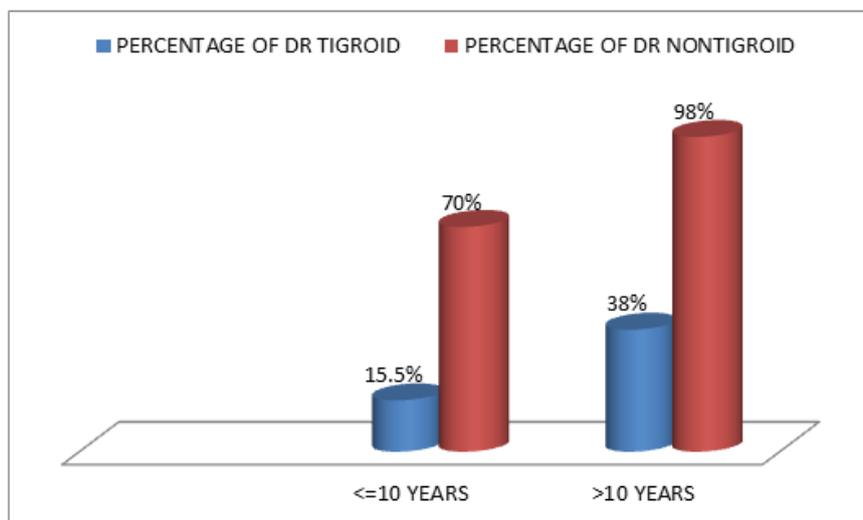
DR was observed to be more in age group 61-70 years in both tigroid and non tigroid fundus. In each age group tigroid fundus has less DR compared to non tigroid fundus. In 41-50 years, 51-60 years, 61-70 years and 71-80 years the incidence of DR in tigroid fundus were 16%, 16%, 44% and 34% respectively, while in non tigroid were 70.5%, 86%, 97% and 85% respectively (FIG 6).



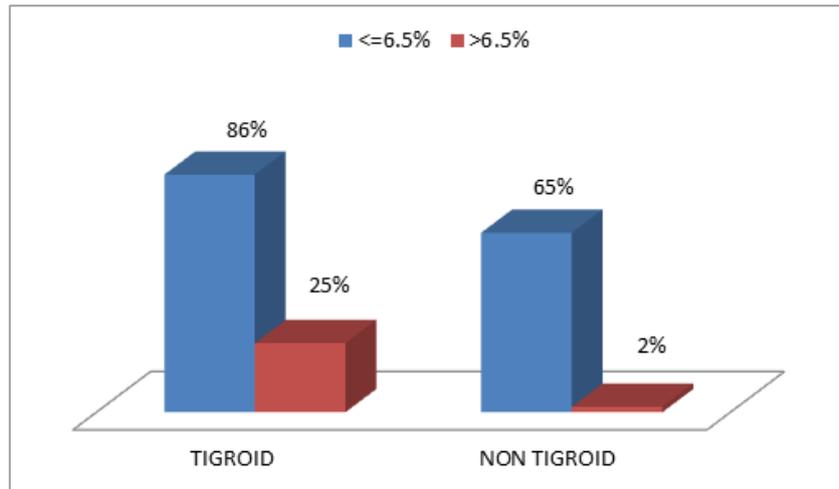
**Fig-1: Relation between Tessellation and Severity of DR**



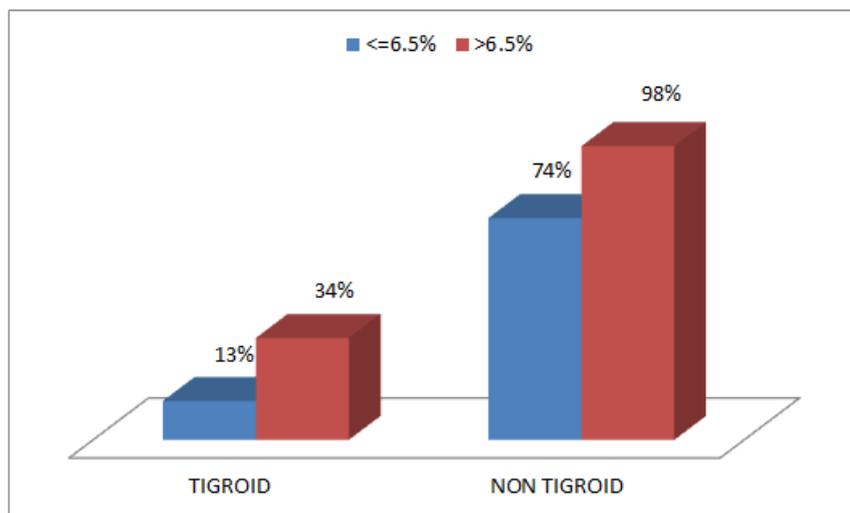
**Fig 2-Duration of Diabetes and Dr**



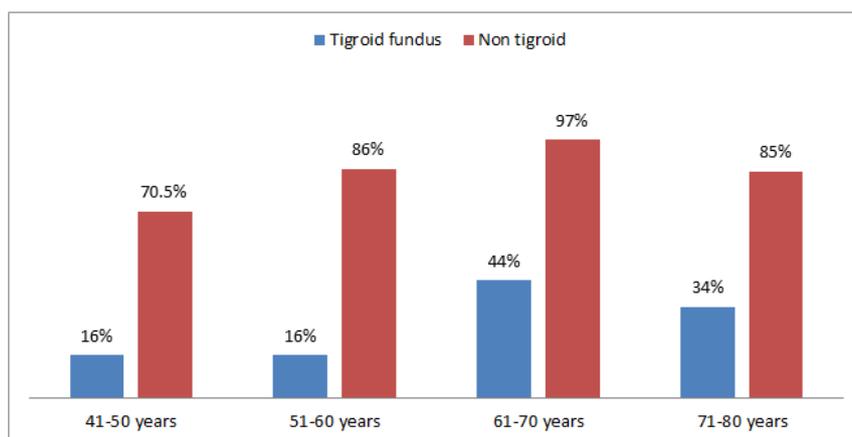
**Fig-3: Incidence of DR in tigrroid and non tigrroid fundus**



**Fig-4: Relation between Hba1c and No DR in Tigroid and Non Tigroid Fundus**



**Fig-5-Relation between Hba1c and Dr in Tigroid and Non Tigroid Fundus**



**Fig-6: DR in Each Age Group**

## DISCUSSION

Diabetes mellitus is a metabolic disorder that affects the efficiency of carbohydrate, protein and fat metabolism due to either partial or complete deficiency of insulin secretion or action. Chronic hyperglycemia

leads to long term damage to various organs, especially the eyes which is the first to be affected. It is estimated that the prevalence of diabetic retinopathy is 34.6% globally and it accounts for 4.8% of total blindness in the world [13]. From various studies, the prevalence of

diabetic retinopathy in India range from 7.3% to 25% [14-19].

There are not many studies related to tigroid fundus and diabetic retinopathy. In our study, out of 100 each of tigroid and non tigroid fundi, DR was absent in 72% of tigroid cases when compared to 13% of non tigroid cases. In a study conducted by Suprada Pokharel *et al.* out of 149 diabetic patients, 59% tigroid had no DR, while only 12% of non tigroid had no DR [10].

Our study showed that DR was observed to be higher in patients with onset of diabetes >10 years (69.5%) than with onset ≤10 years (41.17%). It was similar to the study conducted by META-EYE STUDY GROUP by Joanne W.Y Yan and Sophie L Rogers, which included a total of 35 studies (1980-2008) from 22,896 diabetics, where the prevalence of DR were 21.1% and 76.3% in <10 years and ≥20 years respectively [20]. The Wisconsin Epidemiologic Study of diabetic retinopathy by Klein *et al.* showed that the prevalence of diabetic retinopathy were 17% and 97.5% in patients with diabetes less than 5yrs and 15 or more years respectively [21]. In a study by Haddad *et al.* among Omani diabetes, the risk for DR of more than 10 years duration was increased 8.7 fold compared with duration of diabetes less than or equal to 10yrs [22]. Even with duration of diabetes >10 years, DR was less in tigroid fundus (38%) when compared to non tigrroids (98%) showing tigroid fundus as a protective factor to prevent DR.

In our study, there was also increasing number of proliferative diabetic retinopathy with increasing age. A study conducted by Klein *et al.* in the Wisconsin epidemiologic study, proliferative retinopathy increased from 1.2% to 67% in persons with diabetes for less than 10yrs and 35 or more years respectively [21]. In a study conducted by VatkalisN *et al.* 45.8% of patients who were diabetic for 20 or more years have proliferative diabetic retinopathy, whereas 88.9% of patients with diabetes for less than 5yrs were free of diabetic retinopathy [23].

Among patients with HbA1C ≤6.5%, 86% tigrroids and 25% non tigrroids had no DR. In patients with HbA1C >6.5%, 65% tigrroid and 2% non tigrroids had no DR unveiling tigrroid fundus as a protective factor. It also reveals poor control of diabetes as an increased risk for retinopathy and progression of retinopathy in both tigrroids and non tigrroids. Out of the 77 patients with HbA1C ≤6.5%, only 39 had DR (50.6%) whereas out of the 123 patients with HbA1C >6.5%, 76 had DR (61.5%). According to the META - EYE STUDY group, the prevalence of diabetes with HbA1C ≤7% was 18% and 51.2% with HbA1C >9% [20]. A hospital based study conducted by Agrawal *et al.* showed that in patients having HbA1C level <8%, retinopathy was seen only in 0.04% patients which

increased to 36.4% in patients with HbA1C level more than 10% [24]. Also in a study conducted by Vatkalis N *et al.* a 30% reduction in the risk of micro vascular complications occurred by a 1% decrease of HbA1C concentration [23].

In each age group tigrroid fundus had less DR compared to non tigrroids. Also number of patients with no DR was found to be more in tigrroids as compared to non tigrroids. In a study conducted by Suprada Pokharel *et al.* DR was observed more in age group 41-50 years in non tigrroid compared to 51-60 years in tigrroid group showing that tigrroid fundus has a low risk for DR at an earlier age [10].

## CONCLUSION

Incidence of DR was significantly less in tigrroid fundus compared to non tigrroid fundus. Though there was association between age, HbA1c, duration of diabetes and incidence and severity of DR in both tigrroid and non tigrroid fundus, it was significantly less in tigrroid fundus. Thus tigrroid fundus was observed as a protective factor for development of DR.

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