Evaluation of Macular in Diabetic Patients by Optical Coherence Tomography and Fundus Camera

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Abstract

Preface: Diabetic mellitus type 2 is greatly influenced to macular by increase central macular thickness, change macular appearance and visual function, visual acuity, color vision and central visual field. **Aim:** To evaluate macular in diabetic patients type 2 by using optical coherent tomography and fundus camera. **Methods:** Case control study was conducted in Makkah eye complex located in Khartoum AlRyad, in period (August toDecember2016). Total of 90 patients enrolled in this study; their ages varied between 40 to 65years with (30 healthy patients, 30 controlled diabetes patients and 30 uncontrolled diabetes patients), were asked to participate in the study. Participation was entirely voluntary. Information was collected by interviews and clinical examination. Visual acuity measured by Snellens's E chart, central visual field by amsler chart, color vision by Ishihara test, central macular thickness by OCT (ZEISS-Cirrus HD-OCT model 5000) and macular appearance by fundus camera (ZEISS). The data were analysed using (SPSS 20). **Result:** The research results reveals is greatly influenced to macular in diabetic patients type 2.*Healthy group* study revealed (30%) same affected in color vision and central visual field. The central macular thickness by OCT showed that (>56%) have normal central thickness and with mean 265.7 and SD±94.22 and showed (76.7%) have normal macular appearance. *Controlled diabetes study patients* revealed duration of diabetes range between (1-32) years, 60% with duration (11-20) years mean 12.63 and SD±7.25.More than 38% showed central visual field defect,40% were unable to discriminate colours correctly; showed (56.6%) >250 micro meter indicated an increase in central macular thickness, with mean 320.1 and SD±164.06. Considering appearance using fundus camera; (>33.3%) diabetic maculopathy. *Uncontrolled diabetes study patients* revealed, duration of diabetes

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range (2-35) years, (>53%) with duration (11-20) years, mean 15.75 and SD ±8.35; (>61.7%) showed the same defects in colour vision and central visual field. Considering central macular thickness (75%) indicated an increase in macular thickness >250 micro meters represent with mean 349.2 and SD±144.84. The results obtained by fundus photography 48.3% maculopathy according to CMT found significant differences between normal subjects and uncontrolled diabetes by using pair sample t-tes P-value ≤ 0.001; and not significant with control group P -value > 0.005, furthermore there were no correlation in both groups, P-value > 0.005.Visual acuity indicated significant difference between normal subjects and uncontrolled diabetes by using paired sample t-test P value ≤ 0.001 and not significant with control group > 0.005, furthermore there were no correlation in both groups r > 0.005.

Conclusions: Macular in diabetes patients type2 was influenced by many factors including age, gender and duration of diabetes. Greatly influenced to three quarter (75%) of uncontrolled diabetes patients had shown an increase in the central macular thickness, change macular appearance and visual functional as visual acuity, central visual field and colour vision**.** Longitudinal study is recommended.

Keywords: Diabetes Mellitus, Diabetic Retinopathy, Maculopathy, OCT, Fundus Photography, Functional Vision.

المستخلص:

المقدمة: مرض السكري النوع الثاني يؤثر بشكل واضح علي البقعة الصفراء لشبكية العين حيث يعمل علي زيادة سمكها وتغير شكلها ويؤثر ايضا في الوظائف البصرية مثل (حدة الابصار ، مجال النظر ورؤية الالوان).

الهدف: تقييم البقعه الصفراء لشبكية العين عند مرضي السكري النوع الثاني بواسطه الصوره المقطعية والصوره الملونة.

أسلوب الدراسة: أجريت هذه الدراسه بمستشفي مكة لطب العيون بالرياض في الفتره من أغسطس 2016الي ديسمبر 2016 شملت الدراسه 90 حالة : 30 لايعانون من مرض السكري، 30 من المرضي يعانون من السكري المنتظم و30 من المرضى يعانون من السكري غير منتظم . وقد تراوحت اعمارهم مابين 40-65 عاما. جمعت المعلومات عن طريق الكشف الطبي بعد شرح الاهداف والموافقه علي المشاركه الطوعية بأستخدام برنامج التحليل الاحصائي ورصد البيانات. تم قياس حدة الابصار).قياس مجال النظر بواسطة لوحة امسلر.وقياس رؤيه الالوان بواسطة ايشهارا تست.E chart snellens’s باستخدام (استخدام جهاز تصوير قاع العين وتصوير سمك البقعه الصفراء باستخدام جهاز التصوير المقطعي.

النتائج: أظهرت النتايج ان المجموعة الاولي المرضي الذين لايعانون من السكري وجدت نسبة 30 % من المرضي يعانون من صعوبة في روية الالوان و تشوش في مجال النظر،كما أوجدت الدراسة بجهاز التصوير المقطعي وان 5% منهم سمك البقعة الصفراء لديهم اقل من 200ميكرو متر،56.6 % لديهم سمك طبيعي يتراوح من 200-250 ميكرومتر ونسبة 38.6% يزيد السمك لديهم اكثر من 250 ميكرومتر.كما اظهرت الدراسه بواسطه التصوير الملون ان 16.7%يعانون من اعتلال البقعة الصفراء.

اظهرت الدراسه ان المجموعة الثانية من المرضي منتظمي السكري ان فترة الاصابه بالسكري لديهم تتراوح مابين (1-32)عاما غالبية فتره السكري كانت مابين (11-20)عاما تمثل نسبة 60%. كما ان 38.3% يعانون من تشوش في المجال النظروكما ان 40% من المرضي كانو يعانون من عدم القدرة علي تميز الالوان ،كما اظهرت الدراسه ان 43.3% يعتبرون طبيعي السمك يتراوح مابين 200- 250 ميكرو متر كما اظهرت الدراسه ان 56.6% يعانون من ارتفاع في السمك اكتر من 250 ميكرو متر.كما اظهرت الدراسة بواسطة الصورة الملونة ان 33.3% يعانون من أعتلال البقعة الصفراء.

كما اظهرت الدراسة ان المجموعة الثالثة مرضي السكري الذين يعانون من عدم انتظام نسبة السكري، فتره الاصابة بالسكري لديهم تتراوح مابين (2-32)عاما، غالبيه المرضي كانو في الفتره المرضيه مابين (11-20) عاما يشكلون نسبة 35.4%. ايضا اظهرت الدراسة ان 61.7% من المرضى لديهم عدم مقدره علي رويه الالوان وتشوش في مجال النظر.كما وجد ان 5% لديهم سمك اقل من 200ميكرو متر، و 20% لديهم سمك طبيعي يتراوح مابين 200-250ميكرو متر. ونسبة 75% لديهم ارتفاع في السمك اكثر من 250% . كما اوضحت الدراسه بالصورة الملونة ان48.3% يعانون من اعتلال البقعة الصفراء.

الخاتمه: اظهرت الدراسه ان البقعة الصفراء عند مرضى السكري النوع الثاني تتاثر بعدة عوامل منها: العمر، النوع وفترة الاصابة بالسكري . اوضحت الدراسة ان نسبة 75% من مرضي السكري غير المنتظم هم الاكتر تاثرا حيث وجدث زياده في سمك وسط البقعة الصفراء،وتغير في شكل البقعه الصفراء لشبكية العين و الوظائف البصرية (حدة الابصار،مجال النظر ورؤية الالوان). أوصي باجراء دراسة طولية.

هناك اعباء وواجبات علي اختصاصي البصريات الوفاء بها تجاه مرضي السكري المصابين باعتلال البقعة الصفراء للشبكية اولها تصحيح الاخطاء البصرية، تقديم الرعايه البصرية الاوليه والتثقيف الصحي بالوسائل البصرية واعادة التاهيل.

الكلمات المفتاحية: السكري، البقعه الصفراء، اعتلال الشبكيه، التصوير المقطعي، التصوير الملون، الوظائف البصرية.

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INTRODUCTION

Diabetes mellitus are group of metabolic disorder that characterized by chronic hyperglycaemia, resulting from defects insulin secretion, insulin action or both chronic hyperglycaemia and attendant metabolic deregulation of diabetes mellitus associated with damage in eyes.

Type 2 is most common type of diabetes mellitus, family history and genetic play large role in type 2. It is caused by a combination of peripheral resistance to insulin action and an inadequate compensatory response of insulin secretion by pancreatic beta cells (relative insulin deficiency) approximatly 80 to 90% of patients have type2 diabetes mellitus 1. [1.2]

Diabetic retinopathy (DR) is currently one of the leading causes of blindness in the working-age population in developed countries [3–5]. Diabetic retinopathy is the most common cause of blindness in working age American. The underlying path physiology in diabetic retinopathy involves thickening of the retinal blood vessel wall, micro vascular occlusion, retinal tissue ischemia and finally growth of abnormal new blood vessels, leading to severe complications and loss of functional vision. [6] Epidemiological data show that the prevalence of DR is around 30% in the diabetic population and that the annual incidence varies from 2% to 6%. [7]

Every year, up to 1% of diabetic patients develop serious ocular complications leading to both poor quality of life and a socioeconomic burden. [8]

With regard to the Italian setting, a study conducted in the Veneto Region, using clinical fundus examination, confirmed literature data with a prevalence of DR of 26.6 %.[9]

A significant worldwide increase in the number of persons affected by diabetes has been estimated for the next 10 years, reaching approximately 380 million by 2025, mostly in developing countries. In Europe, compared with 2007, there is expected to be an increase of 10 million persons with a prevalence of diabetes below 10 %.[10]

Diabetic maculopathy is swelling in an area of macula (foveal edema exudates or ischemic).is most common causes of visual impairment in diabetic patients particularly type 2. It is result to accumulation fluid between the outer plexiform and inner nuclear layers. Later it may be involving the inner plexiform and nerve fiber layer. Until entire thickness of the retina become oedematous. Further accumulation of fluid the fovea assumes acystoid macular edema (CME) [11, 12]

Diabetic macular edema (DME) are leading causes of blindness throughout the world and cause significant visual impartment. Color fundus photography has established role in diabetic disease early detection of progression and monitoring of treatment pp. 905–911, 2008 response [15]. Using

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funds photography is low power microscopic with camera backs for photography or electronic equipment for digital imaging of the retina (macula). [13, 14]

Optical coherence tomography (OCT) a non-invasive and noncontact diagnostic method which provide high-resolution cross-sectional image of retina. Is use full in the diagnosis maculopathy (macular edema). [15, 17] Optical coherence tomography (OCT) provides high-resolution cross-sectional imaging and is commonly used in the diagnosis and management of retinal diseases. [18, 20]

In addition to obtain morphological images, OCT can also detect a Doppler frequency shift of reflected light, which provides information on flow and movement. [21, 22]

This study will provide reference and update information for the experienced practitioners and researchers about macular appearance and functions in diabetic patients, increase level of awareness among diabetic population about the disease and contribute towards blindness prevention, the goal of VISION 2020: The Right to sight.

SUBJECTS AND METHODS

Formal letter was sent to the medical manager of Makkah eye Complex through the research supervisor; and written agreement was obtained prior conducting the study to use the hospital instruments and examine patients attending to their clinics.

Descriptive Cross-sectional hospital-based study was selected randomly from Makkah Eye Complex (Khartoum-Alryad). A total of 90 patients; their age varied 40-65years with (30) normal patients and (60) diabetic patients type2 were enrolled and asked to participate in the study. Participation was entirely voluntary. Information was collected by interviews and clinical examination. It has included general information, history, vision taken by international vision chart (E –test), duration of diabetes, medication, visual field examined by central visual field test (amsler chart), colour vision also measured by Ishihara test. Macula evaluated appearance by fundus camera (ZEISS) and central macular thickness measured by OCT (ZEISS-Cirrus HD-OCT model 5000). The collected data was analysed using statistical package for social sciences (SPSS 20).

RESULTS

A total of (90) subjects (180 eyes) were included in this study; Males were 47(52.3%) and 43 (47.7%) were females, the study samples were classified into three groups, each group contains 30 patients. Healthy subjects, controlled and uncontrolled diabetes patients.

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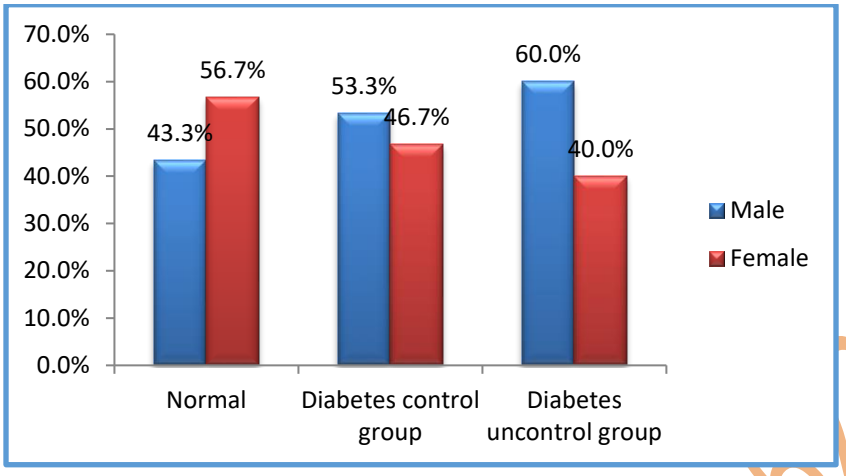

Figure 1: Gender

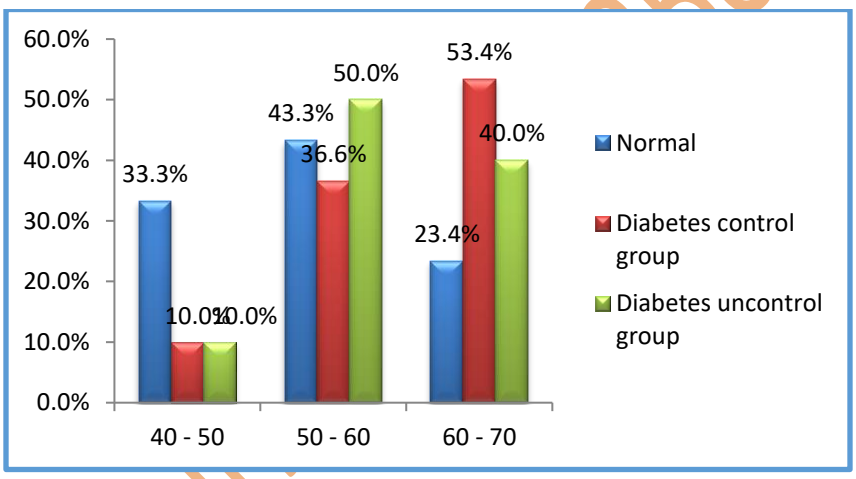

Figure 2: Age

Normal group: Mean age was53.63±8.12, ranged (40-65) years. Controlled diabetes group mean 59.23±5.62, ranged (45-65). Uncontrolled diabetes group mean 59.66±4.90,ranged(45-65).

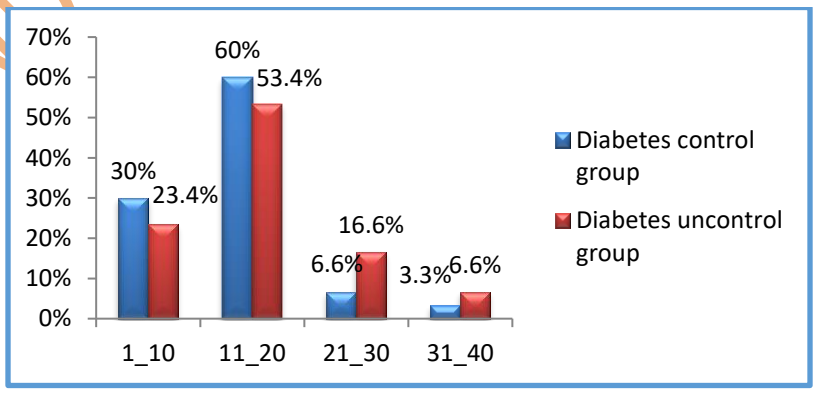

Figure 3: Duration of the diabetes

Controlled diabetes group mean 12.63, SD±7.25, range (1-32) years. Uncontrolled diabetes group: mean 15.73, SD±8.35, range (2-35) years.

Table 1: Medical Treatment for diabetes

	Diabetes Control		Diabetes Uncontrolled	
Status	Freq.	%	Freq.	%
Amaryl 1 mg	4	13.3	9	30
Amaryl 2 mg	3	10	1	3.3
Amaryl 4 mg	1	3.3	1	3.3
Amaryl 3 mg	2	6.7	0	0
Daonil 5 mg	13	43.3	19	63.3
Diet	4	13.3	0	0
Metformain500	1	3.3	0	0
Metformain850	2	6.6	0	0
Total	30	100	30	100

The results showed Daonil 5mg greatly used for both diabetes group B and group C.

Table 2: Visual Acuity

	Normal		Diabetes Control		Diabetes Uncontrolled	
Status	Freq.	%	Freq.	%	Freq.	%
PL	0	0	1	1.7	0	0
0.003	0	0	0	0	1	1.7
0.002	0	0	1	1.7	0	0
0.03	0	0	0	0	1	1.7
0.05	2	3.3	0	0	4	6.7
0.08	1	1.7	1	1.7	0	0
0.1	4	6.7	8	13.3	6	10.0
0.16	4	6.7	4	6.7	8	13.3
0.25	3	5.0	3	5.0	12	20.0
0.3	9	15.0	13	21.7	9	15.0
0.5	9	15.0	15	25.0	10	16.7
0.6	20	33.3	8	13.3	7	11.7
1	8	13.3	5	8.3	2	3.3
Total	60	100	60	100	60	100

The results obtained percentage distribution visual acuity for both eyes in three groups.

Table 2.1: Descriptive statistics of visual acuity of diabetes versus normal subjects

Variable	Mean & SD	Range
Diabetes Control	0.39±0.25	0.005-1.00
Diabetes Uncontrolled	0.31±0.21	0.003-1.00
Normal	0.48±0.27	0.05-1.00

Table 2.2: Paired t-test and correlation of visual acuity

Variable	t-test	Correlation
Diabetes Control	T(1.9) P (0.060)	R(0.030) P (0.822)
Diabetes Uncontrolled	T(-3.8) P (0.000)	R(-0.045) P (0.733)

With regards to above table found a significant difference between normal subjects and uncontrolled diabetes by using pair sample t-test P value ≤ 0.001 and not significant with control group > 0.005, furthermore there were no correlation in both groups P> 0.005

Table 3: central macular thickness.

	Normal		Diabetes Control		Diabetes Uncontrolled	
Range	Freq.	%	Freq.	%	Freq.	%
< 200	3	5	0	0	3	5
200 – 250	34	56.6	26	43.3	12	20
> 250	23	38.4	34	56.6	45	75
Total	60	100	60	100	60	100
Mean & SD	265.722±94.22		320.052±164.06		349.222±144.84	
Range	180-669		200-1174		175-749	

< 200 = Thinner, 200-250 Normal, > 250 Thicker

Table 3.1 Descriptive statistical of central macular thickness of diabetes versus normal subjects

Variable	Mean & SD	Range
Diabetes Control	320.052±164.06	200-1174
Diabetes Uncontrolled	349.222±144.84	175-749
Normal	265.722±94.22	180-669

Table 3.2: paired t-test and correlation of central macular thickness

Variable	t-test	Correlation
Diabetes Control	T(-2.1) P (0.035)	R(-0.072) P (0.582)
Diabetes Uncontrolled	T(-4) P (0.000)	R(0.143) P (0.277)

According to CMT found significant differences between normal subjects and uncontrolled diabetes by using pair sample t-test P ≤ 0.001; and not significant with control group P > 0.005, furthermore there were no correlation in both groups P> 0.005.

Table 4: Amsler test (central visual field)

	Normal		Diabetes Control		Diabetes Uncontrolled	
Status	Freq.	%	Freq.	%	Freq.	%
Normal	42	70	37	61.7	23	38.3
Defect	18	30	23	38.3	37	61.7
Total	60	100	60	100	60	100

In this table in group A 30% defect central vision, 38.3% for group B and group C showed greatly central visual field defect 61.7%.

Table 5: colour vision test.

	Normal		Diabetes Control		Diabetes Uncontrolled	
Status	Freq.	%	Freq.	%	Freq.	%
Normal	21	70	18	60	7	23.3
Defect	9	30	12	40	23	76.7
Total	30	100	30	100	30	100

For colour vision test: showed uncontrolled diabetes group C 76.7%failed to colour vision test greatly influenced than other groups.

Table 6: macular appearance (fundus photography)

	Normal		Diabetes Control		Diabetes Uncontrolled	
Status	Freq.	%	Freq.	%	Freq.	%
Normal	46	76.7	25	41.7	18	30.0
None perforation retinopathy	4	6.7	14	23.3	9	15.0
Maculopathy	10	16.7	20	33.3	29	48.3
Perforation retinopathy	0	0	1	1.7	4	6.7
Total	60	100	60	100	60	100

DISCUSSION

The findings of the study showed males more than females in diabetic groups, agree with (Stuart.Y.K *et al* 2014)[23].Have study central macular thickness in diabetic patients gender, males had greater central macular thickness than female by 12microns.

Regarding to duration of diabetes, controlled diabetes patients range between (1-32) years, majority diabetic duration (11-20) years 60% mean12.63±7.25 and uncontrolled diabetes patients range between (2-35) years, the frequent diabetic duration (11-20) years represent 53.4% mean 15.75 ± 8.35(figure3) agree with (Voutilation-Kauristor, Terssvirta and Niskonenl 2001)[24].

The results showed Daonil 5mg greatly used for both controlled diabetes patients and uncontrolled diabetes patients (table 1). Found a significant difference between normal subjects and uncontrolled diabetes P- value ≤ 0.001 and not significant with control group > 0.005, furthermore no relation found in both groups P-value > 0.05.(table2)

According to CMT the main result revealed that their decrease to thicker in CMT in control and thickest for the uncontrolled group then found a significant differences between normal subjects and uncontrolled diabetes P- value ≤ 0.001; while not significant with control group > 0.005, no relation in both groups P-value > 0.005.(table3).

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Central visual field indicated that 30%of the cases showed defect of central visual field in health group, controlled diabetes group revealed 38.3%defects central visual field and uncontrolled diabetes group showed 61.7% defect central visual field. This result reflected un-controlled diabetes patients more effect on central visual field than other groups. (table4) The purpose of the visual field assessment in this study to assessed central visual field defects with amsler chart because its accurate test to detecting macular disease similar finding were agree with (Mostafa.K Nasser 2014).[25]

Colour vision in healthy or normal group 30% failed to evaluate colour vision test, while controlled diabetes patients 40% are not able to discriminate color and showed in uncontrolled diabetes patients 61.7% failed to detect color. Majority defect appear in un-controlled diabetes patients (table5) those agree with (BE Wolff –Bearse, M.A and JrmEschnech 2014)[26]and (Tarek.M.et al 2015)[27].

In term of macular in healthy group Non-proliferation retinopathy represent 6.7% and diabetic maculopathy 16.7%; then controlled diabetes patients 23.3% had non-proliferative retinopathy, 1.7% proliferation retinopathy and 33.3%diabetic maculopathy comparing with uncontrolled diabetes patients15%had non-proliferative retinopathy,6.7%proliferation retinopathy and 48.3% maculopathy (table6). Have study compare fundus photography and OCT to evaluation diabetic retinopathy, assessment of fundus photography and OCT detected more eyes with higher grades of DR OCT allow to objective evaluation diabetic maculopathy (V Manjunath V Papastavrou and J Talks (2014)[28] were obtained greatly influence of maculopathy in un controlled diabetes patient.

CONCLUSION

Macular in diabetes patients type2 was influenced by many factors including age, gender and duration of diabetes. Greatly influenced to three quarter (75%) of uncontrolled diabetes patients had shown an increase in the central macular thickness, change macular appearance and visual functional as visual acuity, central visual field and colour vision**.**

RECOMMONDATIONS

The role of optometrist in diabetic patients (diabetic maculopathy) to help the patients with impaired vision to correct refractive errors and benefits from low vision and rehabilitations services. Eye examinations should be undertaking routinely especially for diabetic patients and Increase the awareness about side effect of diabetes mellitus and the importance of treatment (Poster and Leaflet).

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Suggestion future studies should be considered Increase sample size. Conduct longitudinal studies. Evaluation other macular parameters and Compare both types of diabetes type1 insulin dependent and type2 non-insulin dependent.

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