

Study of the retinal vascular changes in the transition from diabetic to diabetic retinopathy eye

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Abstract—An attempt to investigate the vascular changes at the transition from R0 to R1 (non-retinopathy to first stage of retinopathy) is made in this article. Thirty images from the right eye of fifteen patients were used (one at the year before retinopathy and one after) and width measurements were taken from six large vessel segments in junctions (three from arteries and three from veins).

I. INTRODUCTION

Diabetic retinopathy (DR) is a major disease, which leads to blindness. Early detection of the vascular changes is vital for the right treatment early before the condition is irreversible. In this article we are trying to investigate the changes that occur during the transition from healthy diabetic eye to first stage of DR eye. Eighteen measurements of widths (in pixels) and six measurements of branching angles (in degrees) from the right eye per image were measured using a manual tool that has been developed by *Al-Diri et al.* [1].

II. METHOD

The manual tool helps us select the vessels we want to measure and calculate the widths using a rectangle which is adjustable according to the boundaries of each vessel. In each bifurcation, the centerline of the parent and children vessels is marked manually in order to define the branching angle. Since the measurements are taken from the same experienced person, we consider the intra-rater errors between each image of the same patient to be consistent, since the images before and after retinopathy are almost identical and of the same quality and resolution (3216-by-2136 pixels).

In literature, some methods have been proposed for extracting measurements using Gaussian profile [2] and edge detection techniques with matched filter [3]. In our case it is crucial to select the exact points between the two images of the same patient, making the manual tool an ideal solution.

The measurements of the widths and angles for the two groups (before retinopathy and after retinopathy) were evaluated using a paired two-tailed t-test, to test the hypothesis that there is a statistically significant difference in angles and/or widths between the two groups.

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III. RESULTS

It was found that the mean width of the arteries in non-retinopathy patients was 17.6 (SD 2.95) and in retinopathy patients 17.12 (SD 3.16). For the veins the values were 20.71 (SD 2.53) and 20.83 (SD 2.35) respectively. Regarding the angles for non-retinopathy patients the mean values were 124.93 (SD 12.22) and 119.8 (SD 8.54) for arteries and veins respectively. In the retinopathy groups the mean values for arteries and veins were 124.29 (SD 9.17) and 127.89 (SD 6.01) respectively.

As far as the branching angles of the veins are concerned, an increase of the angles was observed to the retinopathy group achieving significance (p-value=0.034) with a correlation $r=0.05$ (p-value=0.892). On the contrary no significant result was found for the bifurcation angles of the arteries (p-value=0.894) having a correlation value $r=0.087$ (p-value=0.811).

Regarding the measurements of the widths, no correlation was found between the widths before and after retinopathy neither for the arteries nor for the veins (p-value=0.463 and p-value=0.865, respectively and $r=0.792$ (p-value=0.006) and $r=0.586$ (p-value=0.075), respectively).

IV. CONCLUSION

Studying the alterations in the vasculature during the progress of the systemic disease of diabetes is a very demanding task, employing both the functional impairment and the vascular geometric changes. A clear view of what exactly happens in the transition level from diabetic eye to DR eye can give us indications of the early changes, which can be further investigated by using more images of the same patient for the years before DR. This is the logical next step of our research, which will include even more geometric measurements as well as some physiological parameters (oxygen perfusion, heart rate, blood pressure etc.).

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