ALIGNMENT OF OPTIC NERVE HEAD OPTICAL COHERENCE TOMOGRAPHY B-SCANS IN RIGHT AND LEFT EYES

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INTRODUCTION

- ✓ **Symmetry analysis of right and left eyes can be a useful tool for early detection of eye diseases.**
- ✓ **This work is useful for comparing CDRs (Cup to Disk Ratio) as an important descriptor to investigate the symmetry in two eyes.**
- ✓ **Using aligned B-scans, two signals of CDRs are obtained from two eyes which each point in these signals corresponds to CDR in a specific part of ONH.**

OBJECTIVES

How are the equivalent B-scans estimated in two eyes?

- ✓ **This alignment is done by alignment fovea-ONH axes with horizontal line.**

The field of view in OCT data does not cover both fovea and ONH , so we do two steps:

- ✓ **Registration of fundus image with its corresponding OCT data.**
- ✓ **Alignment of fundus images of eyes by extraction of the center of fovea and ONH (fovea-ONH axes).**

METHOD

The steps used for estimating the equivalent B-scans is explained as follow:

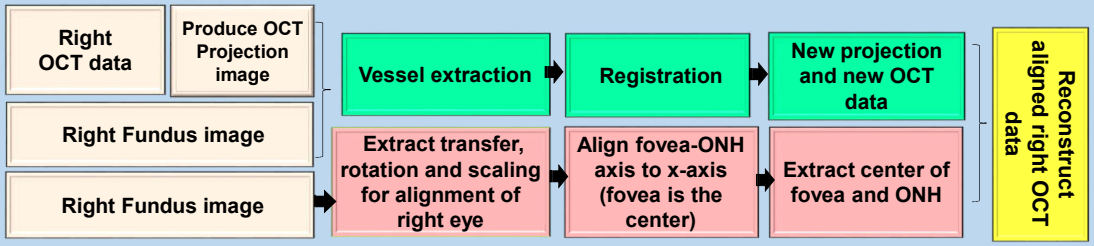

Figure 1: The proposed algorithm for alignment of OCTs in right eye. Similar procedure is done for left eye.

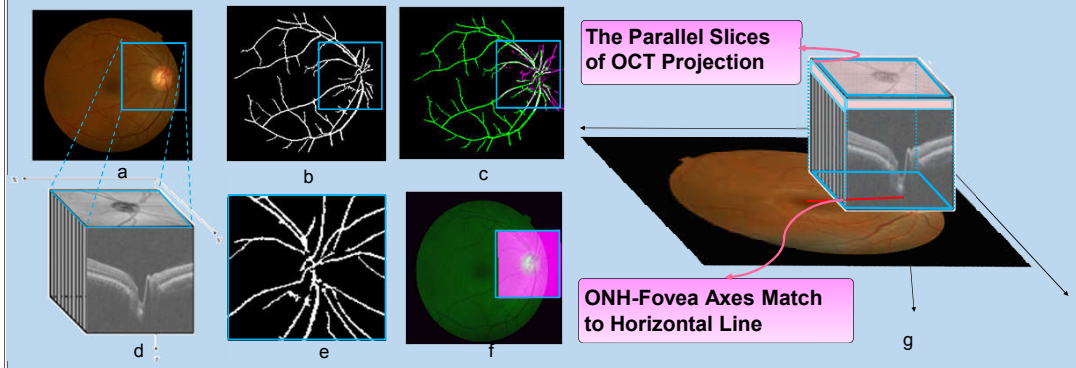

Figure 2: Registration of projection of OCT data and OCT data with fundus image. b and e are extracted vessels from fundus and OCT projection images a and d . c and f are the results of registration(c are vessels plan, f are main images). And g is the result of registration of OCT data to corresponding alignment fundus

1. Registering fundus image with projection of OCT :

It is necessary to connect multimodality data. So, in the first step, the enface presentation of OCT (projection of OCT) is registered to fundus image. Then, all 2D slices in 3D OCT which are parallel to this projection would be changed using the obtained registration parameters for projection image.

The multi-step correlation function is used to register blood vessels of fundus image and projection of OCT data. The extracted vessels are fed to similarity function to show the best shift, rotation and scaling as follows:

a) The OCT projection image is scaled around a proximate amount and for each size the correlation image is obtained.

b) The obtained image is rotated from -15 to 15 degree and for each degree the correlation image is calculated.

c) The maximum pixels in correlation function is shown the best scale and rotation and best shift.

2. Alignment of fundus images of left and right eyes :

The first step for aligning two fundus images is, selecting the base points for alignment. This two points are the center of macula and ONH .

i. Finding the center of macula and ONH : The macula center is found by searching darkest pixel in center of image and the initial estimate of center of ONH is obtained by searching the brightest pixel in fundus image. The estimated center of ONH can be improved using active contour.

ii. Aligning Fovea-ONH axes with horizontal line.

3. Alignment of right and left B-scan OCT data :

For aligning B-scan OCT data of right and left eyes, the parallel slices to OCT projection image of each eye are aligned by using the same parameters obtained for OCT projection image (Figure 2).

RESULT

- ✓ **Using this algorithm :We can compare the corresponding B-scans before and after alignment visually. Our results show that after alignment, the depth of disc in equivalent B-scans are more similar than before alignment (Figure 3-a,b).**
- ✓ **By each B-scan, we can estimate CDR[2] in a specific equivalent region.**
- ✓ **A point-to-point comparison between CDRs of right and left eyes is provided which has potential to lead to a new imaging biomarker for eye disease detection (Figure 3-c).**

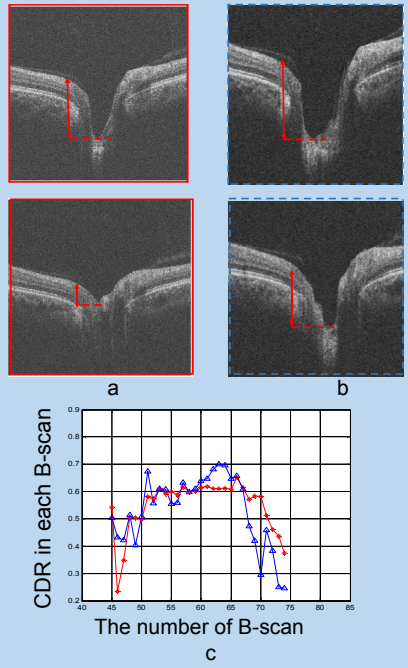

Figure (3):a show corresponding B-scans in left and right eyes before alignment, b show corresponding B-scans in left and right eyes after alignment, c is the CDRs of left and right eyes after alignment

CONCLUSION

- ✓ **Most of similar works perform the comparison between CDRs without using any automatic alignments between OCTs [1] and we tried to improve the comparison by alignment .**
- ✓ **We used this approach to compare the clinical features in both eyes such as local cup-to-disc ratio which can be used to extract similarity indexes between right and left eyes (for comparing normal and abnormal subjects). So, this alignment can help to better evaluate the real symmetry in normal subjects.**