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# The Role of Optical Coherence Tomography in Diagnosis and Grading of Papilledema and its Correlation to Clinical Assessment

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## ABSTRACT

**Background: Papilledema, or optic disc swelling because of elevated intracranial pressure, was sorted using the Frisen Scaling. Optical coherence tomography (OCT) is a possible device to measure variations in the degrees of papilledema and to display the effectiveness of treatments. Objective: To identify and correlate the role of the OCT of the optic nerve head with the clinical grading of papilledema using the Frisen Scale via digital fundus photographs. Patients and methods: This was a randomized trial in which 50 eyes with papilledema have been enrolled from the cases attending the outpatient clinic of Beni-Suef University Hospital. Digital optical disc photos of the left or right eye have been chosen for comparison with OCT optic nerve head (ONH) images results. To correlate OCT results with clinical grading of papilledema using the Frisen scale. Results: There was a highly significant association between stages of papilledema by OCT and stages of papilledema by modified Frisen scale (p.value<0.001). A strong positive significant association among stages of papilledema by OCT and stages of papilledema by modified Frisen scale (r= 0.871, P <0.001). Conclusion: Present OCT measurements may be beneficial as an adjunct to clinical grading. For lower-stage anomalies, OCT compares positively with clinical grading of optic nerve photos. With elevated stages, OCT-RNFLT processing algorithms frequently failed.**

**Keywords:** Optical Coherence Tomography, Papilledema, Frisen Scale.

## INTRODUCTION

The term papilledema describes swelling of the intraocular prelaminar portion of the head of the optic nerve that rises from high intracranial pressures, transferred through the cerebrospinal fluids (CSF) situated within the retro-bulbar optic nerve sheath [1]

The optic nerve frequently looks higher in papilledema patients with accompanying blurred disc boundaries and obscurations of main vessels. In some patients, associated bleedings and cotton wool spots can be detected near the edematous disc, fundus characteristics that may aid to recognize true papilledema from other reasons of optical disc elevations including thickenings of the peripapillary-RNFL, telangiectatic disc vessels, and obscurations of branching vessels at disc boundary [2]. Yet, intra-observer conformity as regards the papilledema stage is comparatively poor even between qualified inspectors when utilizing Frisen scaling [3].

The swelling is frequently bilateral, unilateral presentations are very infrequent. In intra-cranial HPT, the optical disc swelling most commonly occurs bilaterally. When papilledema is found on fundoscopy, additional assessment is necessary as vision loss may resulted if the causing disorder isn't managed. Additional assessment with a CT or MRI of the brain and/or spine is regularly accomplished **[4].**

Papilledema is the swelling of the optical disc because of elevated intracranial pressure, was staged using the Frisén Scaling. This scale utilizes visual characteristics of the optical disc and peripapillary retina to stage optical disc edema. Its re-producibility was validated but it is restricted by the usage of an ordinal scale **[5].**

Various imaging modalities were utilized to evaluate the topography of ONH in papilledema cases. From monocular color fundus photos, papilledema may be quantified subjectively via the Frisén scale by taking into account visual characteristics of the optical disc margins and the manifestation of dis-continuity of blood vessels as they progress over the ONH **[6]**.

OCT, meanwhile the development of the ophthalmo-scope an edematous optical disc form was detected as an acute appearance of optical nerve injuries, resulting from the myriad of possible mechanisms counting optical disc drusen, ischemia, demyelination, infiltrations, and elevated intra-cranial pressures. Despite the clear value of fundoscopy in clinical settings, this method is restricted by the qualitative nature of the assessment [7]**.**

OCT was experienced many developments and transformed the diagnostic, monitoring, and treatment methods to several retinal disorders and glaucoma. Computerized algorithms may be employed on the high-resolution pictures attained via recent OCT apparatusess to recognize and measure the breadths of separate retinal layers, counting the macular ganglion cell complex (GCC), RNFL, and choroid **[8]**.

Few reports assessed the usage of OCT in the measurement of RNFL or entire retinal thickening because of papilledema; a report comparing the results of OCT versus disc photos in kids with idiopathic intracranial HPT **[9].** One more study compared OCT-RNFLT and OCT entire retinal thickness with fundus disc photos in adult patients having elevated intra-cranial pressures and stated that OCT compared favorably with clinical grading of optical nerve photos **[5].**

This work aimed to identify and correlate the role of the OCT of the ONH with the clinical grading of papilledema using the Frisen scale via digital fundus photographs.

## PATIENTS AND METHODS

This was a randomized study in which 50 eyes have been enrolled from the cases attending the outpatient neurology and ophthalmology clinics of Beni-Suef university hospital.

Digital optical disc photos of the left or right eye have been chosen for comparison with OCT ONH pictures results. To correlate OCT results with clinical grading of papilledema using the Frisen scale.

All the cases included in this study underwent RNFLT measurement at Beni-Suef university hospital ophthalmology department by SD-OCT from Jan 2020 to Dec 2020.


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**Ethical Consent**

The work received ethical approvals from the faculty of medicine, Beni-suef university research ethical committee. The nature of the research was clearly explained to each patient. Informed written consent was obtained.

**Inclusion Criteria**

Patients with papilledema (due to IIH), age: 20-60 years, and clear anterior segment media allowing clear fundus photography and OCT imaging.

**Exclusion Criteria**

Any other reasons of swelling of optic disc like, Optic disc drusen, anterior ischemic optic neuropathy, glaucomatous patients, neurodegenerative disorders that affect RNFLT such as Parkinson's disorder, Multiple sclerosis, high hypermetropic patients, and history of uveitic attacks and retinal dystrophies.

**Statistical Analysis**

Collected data were statistically analyzed via IBM-SPSS-25 (USA). Chi-square testing ($\chi 2$) to estimate variance among two or more groups of qualitative variables. Quantitative data have been presented as mean ± SD. ANOVA (f) testing: was a significance examination utilized for comparing 3 or more groups having quantitative variables. Kruskal-Wallis testing (non-parametric testing): was a significance examination utilized for comparing among 3 or more groups with non-normal distribution having quantitative variables. $P<0.05$ was judged significant.

## RESULTS

This study enrolled 50 eyes from the cases attending the outpatient clinic of Beni-Suef university hospital. Digital optical disc photos of the left or right eye have been chosen for comparison with OCT ONH images results to correlate OCT results with clinical staging of papilledema using Modified Frisen Scaling. The patients' population included fifty eyes distributed as 42 (84%) females and 8 (16%) males, their age median was 31 years and ranging between 20 and 56 yrs with Mean ± SD 36.08±12.47 years, in 25 (50%) patients the right eye was examined, while in the other 25 (50%) the left eye was examined.

**Table (1): Association between stages of papilledema by OCT and stages of papilledema by modified Frisen scale.**

| | | | P. Stage OCT | | | | $X^2$ | P |
|---|---|---|---|---|---|---|---|---|
| | | | Stage 1 | Stage 2 | Stage 3 | Total | | |
| P. Stage MFS | Stage 1 | N | 12 | 0 | 0 | 12 | 37.556 | 0.001< |
| | | % | 24% | 0.0% | 0.0% | 24% | | |
| | Stage 2 | N | 0 | 26 | 0 | 26 | | |
| | | % | 0.0% | 52% | 0.0% | 52% | | |
| | Stage 3 | N | 0 | 4 | 0 | 4 | | |
| | | % | 0.0% | 8% | 0.0% | 8% | | |
| | Stage 4 | N | 0 | 4 | 4 | 8 | | |
| | | % | 0.0% | 8% | 8% | 16% | | |
| Total | | N | 12 | 34 | 4 | 50 | | |
| | | % | 24% | 68% | 8% | 100.0% | | |

There was a highly significant association between stages of papilledema by OCT and stages of papilledema by modified Frisen scale (p<0.001)

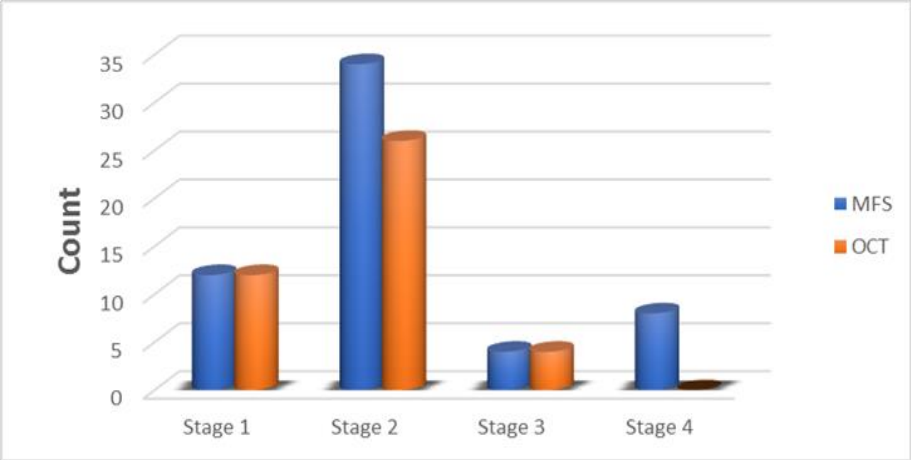
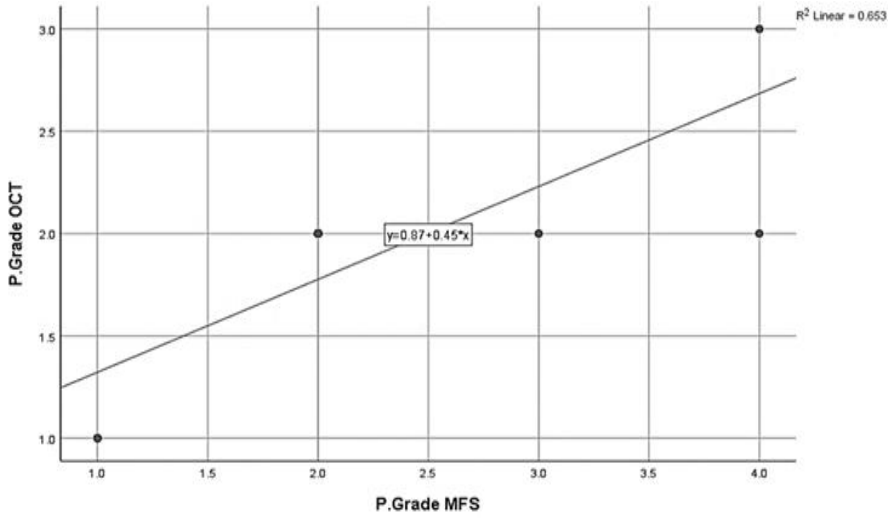



**Table (2): Correlation between stages of papilledema by OCT and stages of papilledema by modified Frisen scale.**

| Studied Parameters | P. Stage OCT | |
|---|---|---|
| | R | p-value |
| P. Stage MFS | 0.871 | <0.001 |

A positive significant association was found among stages of papilledema by OCT and stages of papilledema by modified Frisen scale (r= 0.871, P= <0.001).




## DISCUSSION

The patient population included fifty eyes distributed as 42 (84%) females and 8 (16%) males, their age median was 31 years and ranging between 20 to 56 yrs with Mean ± SD 36.08±12.47 yrs, in 25 (50%) patients the right eye was examined, while in the other 25 (50%) the left eye was examined.



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Our results were supported by the study of **Dreesbach et al.** [10] as they reported that the ages of the cases with IIH was 30±11 yrs and of the controls 30±10 yrs (P.value= 0.34). 95% of cases with IIH and 96% of the control group were females (P.value = 0.93).

In the study of **Mohamed et al.** [11], 30 patients with papilledema,26 females with mean age 28.2±6.7 and 4 males with mean age 32±2 years.

The present study showed that the RNFLT median was 108.5 and ranged from 84 to 152 with Mean ± SD 112.04±19.79, while the BCVA median was 0.80 and ranged from 0.50 to 1.00 with Mean ± SD 0.78 ±0.16.

Our results were supported by the study of **Khalil and Labib,** [12] as they reported that although the initial average RNFLT was elevated significantly than that of the healthy control group, it was elevated than normal databases in 40 % of patients, within ordinary in 32 % of patients, and below ordinary in 28 % of patients.

The usage of noninvasive imaging methods like OCT can be a good way to improve the diagnosing and the follow-up of these cases. Preceding reports have revealed that OCT can be beneficial in evaluating the optical disc edema via counting the thickness of the peripapillary-RNFL. Because of the spectral technologies OCT (SD-OCT), the acquisitions of elevated resolution 2D and 3D sectional pictures of the optical disc, and the peripapillary-RNFL and the macular area allowed substantial developments in diagnostics. But it is vital to state that in patients with severe edema (≥stage-III in the Frisen scaling), the quantification of papilledema via the measurements the of thickness of the peripapillary-RNFL attained using OCT can be subjected to errors made by flaws in the demarcations of the higher and lower borders of the peripapillary-RNFL, that can avoid more precise estimation of edema intensity [13].

The current study showed that the papilledema was distributed according to OCT into 12 (24%) stage 1, 34(68%) stage 2, and 4(8%) stage 3. The papilledema was distributed according to the modified Frisen scale into 12(24%) stage 1, 26(52%) stage 2, 4(8%) stage 3, and 8(16%) stage 4. There was a highly significant association between stages of papilledema by OCT and stages of papilledema by modified Frisen scale ($p<0.001$). There was a strong positive significant association among stages of papilledema by OCT and stages of papilledema by modified Frisen scale ($r= 0.871$, $P <0.001$**).

Our results were supported by the study of **Scott et al.** [5] as they reported that between 36 cases with papilledema, 19% were stage 0, 19% were stage 1, 28% were stage 2, 4 had stage 11%, and 22% were stage 4-disc edema via majority rule.

However, in the study of **Mohamed et al.** [11], they found that 7(21) % had stage 1, 10(30) % had stage 2, 4(12) % had stage 3, 9(27) % had stage 4. They revealed a strong association between the MFS and OCT results. When OCT-RNFLT was matched to the MFS stage from photos (using majority rule), Spearman rank association was 0.727 (Pvalue=.0005). When OCT entire retinal thickness was matched to MFS stage from photos, Spearman rank association was 0.789 (P_.0005).

Our results were supported by the study of **Nguyen et al.** [14] as they reported that the average value of RNFLT was significantly higher in the moderate-severe PO patients than in the mild PO (pvalue<0.001) and controls (pvalue<0.001). But, average RNFLT was not significantly changed in the mild PO patients vs. the controls (p value=0.17). The 2-way ANOVA revealed an influence of group and the quadrant on the RNFLT (F (6, 129) =20, pvalue<0.001). Although average RNFLT values were significantly higher in all quadrants in the moderate-severe PO patients than in the mild PO (p<0.001) and controls (pvalue<0.001), there were nonsignificant changes in RNLFT in the mild PO group vs. the controls in every quadrant (temporal, p value=1; superior, p=1; nasal, pvalue=1; inferior, pvalue=0.9).

**Khalil and Labib,** [12] demonstrated that In IIH cases the initial RNFLT was significantly elevated, while GCC (ganglion cell complex) was significantly low in comparison to the control group (P.value= 0.045 and 0.004, resp.). The value of ICP measured has been revealed to have a positive correlation with the stage of papilledema (r = 0.494, P.value= 0.000). The ultimate recordings revealed that a significant reduction in GCC and RNFL values (P.value = 0.000 and 0.002, resp.), and development in mean deviation (P.value = 0.003).

According to **Scott et al.** [5], they reported a strong association between the MFS and OCT results. When OCT-RNFLT was in comparison to the MFS stage from photos, Spearman rank association was 0.85 (P.value< 0.001). When OCT entire retinal thickness was matched to the MFS stage from photos, Spearman rank association was 0.87 (P.value < .001). In cross-check staging by one of us (L.F.), Spearman rank associations were 0.79 (P.value< 0.001) and 0.83 (P.value< 0.001) for the latter.

Furthermore**, Mohamed et al.** [11] revealed that OCT-RNFLT and entire retinal thickness revealed a significant association with the MFS stage from Photos. In staging papilledema, they revealed a significant connection among the MFS and OCT results. When OCT-RNFLT was matched to the MFS stage from photos, Spearman's rank association was 0.727 (P.value=.0005). When OCT entire retinal thickness was matched to MFS stage from photos, Spearman rank association was 0.789(P.value=.0005).

Our results prove that OCT and MFS are complementary approaches that may be utilized for following-up papilledema cases, OCT measurements can be useful in papilledema grading, For lower stages, papilledema OCT compared favorably with clinical grading using MFS but with higher stages, OCT-RNFLT processing algorithms frequently fails.

## CONCLUSION

Present OCT measurements may be beneficial as an adjunct to clinical grading. For lower-stage anomalies, OCT compares positively with clinical grading of optic nerve photos. With elevated stages, OCT-RNFLT processing algorithms frequently failed.

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