



www.bioinformation.net
Volume 22(3)



Research Article

Received March 1, 2026; Revised March 31, 2026; Accepted March 31, 2026, Published March 31, 2026

DOI: 10.6026/973206300221905

SJIF 2026 (Scientific Journal Impact Factor for 2026) = 8.478

2022 Impact Factor (2023 Clarivate Inc. release) is 1.9

Declaration on Publication Ethics:

The author's state that they adhere with COPE guidelines on publishing ethics as described elsewhere at <https://publicationethics.org/>. The authors also undertake that they are not associated with any other third party (governmental or non-governmental agencies) linking with any form of unethical issues connecting to this publication. The authors also declare that they are not withholding any information that is misleading to the publisher in regard to this article.

Declaration on official E-mail:

The corresponding author declares that lifetime official e-mail from their institution is not available for all authors

License statement:

This is an Open Access article which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly credited. This is distributed under the terms of the Creative Commons Attribution License

Comments from readers:

Articles published in BIOINFORMATION are open for relevant post publication comments and criticisms, which will be published immediately linking to the original article without open access charges. Comments should be concise, coherent and critical in less than 1000 words.

Disclaimer:

Bioinformation provides a platform for scholarly communication of data and information to create knowledge in the Biological/Biomedical domain after adequate peer/editorial reviews and editing entertaining revisions where required. The views and opinions expressed are those of the author(s) and do not reflect the views or opinions of Bioinformation and (or) its publisher Biomedical Informatics. Biomedical Informatics remains neutral and allows authors to specify their address and affiliation details including territory where required.

Edited by P Kanguane

Citation: Mishra *et al.* Bioinformation 22(3): 1905-1909 (2026)

Ocularultrasound versus SD-OCT in early papilledema differentiation

Aditi Mishra^{1,*}, Sankriti Ukey¹, Ankita Baghel¹, Eva Rani Tirkey² & Sachin Parmar³

¹Department of Ophthalmology, Nand Kumar Singh Chauhan Medical College, Khandwa, Madhya Pradesh, India; ²Department of Ophthalmology, Shyam Shah Medical College, Rewa, Madhya Pradesh, India; ³Department of Community Medicine Department V.K.S. Government Medical College, Neemuch, Madhya Pradesh, India; *Corresponding author

Affiliation URL:

<https://www.gmckhandwa.org/>

<https://ssmcrewa.ac.in/>

<https://vksgmneemuch.org/>

Author contacts:

Aditi Mishra - E-mail: aditimishra5383@gmail.com; Phone: +91 7724845248

Sanskriti Ukey - E-mail: sanskritikey97@gmail.com; Phone: +91 9424981755
 Ankita Baghel - E-mail: ankibaghel24@gmail.com; Phone: +91 8305948114
 Eva Rani Tirkey - E-mail: tirkeyeva652@gmail.com; Phone: +91 9300404990
 Sachin Parmar - E-mail: dr.sachinparmar@gmail.com; Phone: +91 9993813103

Abstract:

Differentiating early papilledema from pseudopapilledema remains a considerable diagnostic challenge in neuro-ophthalmology due to the risks surrounding unnecessary neuroimaging or under-treatment of elevated ICP. Therefore, it is of interest to study of ocular ultrasonography and SD-OCT was carried out in 60 patients with elevation of the optic disc from September 2022 to February 2024. Papilledema was defined as optic nerve sheath diameter >3.3 mm, a positive 30° test and crescent sign while pseudopapilledema was often associated with hidden disc drusen. SD-OCT had higher sensitivity than ultrasonographic examination (86.7% vs 81.7%) and eyes with papilledema showed thicker peripapillary RNFL, increased ONH volume, decreased GCIPL, enlargement of the blind spot or reduced contrast sensitivity and colour desaturation. The two modalities complement each other - SD-OCT provides quantification and allows differentiation whereas ultrasonography can show anatomical biomarkers, together allowing the early detection of intracranial hypertension as well as avoiding invasive investigations in cases of pseudopapilledema.

Keywords: Papilledema, optic disc drusen, tomography, optical coherence.

Background:

Optic disc elevation represents a diagnostic challenge in neuro-ophthalmology clinics and necessitates accurate discrimination between true papilledema and pseudopapilledema. Papilledema is defined as optic disc swelling resulting from raised intracranial pressure and mandates prompt identification to avert irreversible visual loss or address life-threatening causes such as intracranial mass lesions or venous sinus thrombosis [1]. Pseudopapilledema, in contrast, refers to optic nerve head (ONH) elevation due to anomalous anatomical variants, most commonly optic disc drusen or congenital anomalies and does not pose the same risk profile or require urgent intervention. Clinical distinction between these two conditions is often complicated by overlapping fundus features such as blurred disc margins, elevation, or absence of physiological cupping [2]. Traditional evaluation of optic disc elevation relies on a combination of comprehensive clinical examination, fundus photography and ancillary tests. Standard visual function assessments, including perimetry and visual acuity measurement, generally lack specificity in differentiating mild papilledema from pseudopapilledema [3]. Fundoscopic findings such as venous pulsations, presence of disc hemorrhages, or macular exudates can aid in diagnosis but may not be definitive, particularly in cases of early or low-grade disc edema. Consequently, noninvasive, objective imaging modalities have been increasingly utilized to enhance diagnostic accuracy in cases of optic disc elevation [4, 5]. Ocular ultrasonography offers real-time structural assessment of the optic nerve sheath and retrobulbar space. The optic nerve sheath diameter (ONSD), measured using B-scan ultrasonography, has emerged as a clinically useful parameter; an ONSD of ≥ 3.3 mm, especially with a positive 30-degree test (demonstrating sheath compliance), strongly suggests papilledema [6]. Sensitivity of this measure in distinguishing papilledema from pseudopapilledema has been consistently high, with reported values up to 90%, although specificity may be somewhat lower due to overlap with some anatomic variants [7]. Ultrasonographic signs such as the "crescent sign" and the

absence of visible buried optic disc drusen further improve diagnostic yield in differentiating true from false disc edema [8]. Spectral-domain optical coherence tomography (SD-OCT) enables high-resolution cross-sectional imaging of the retinal nerve fiber layer (RNFL) and ONH architecture. Peripapillary RNFL thickening is a characteristic of papilledema, reflecting axoplasmic flow stasis at the ONH, while in pseudopapilledema, RNFL thickening is generally mild or absent. SD-OCT also quantifies optic nerve head volume (ONHV), Bruch's membrane opening (BMO) and ganglion cell-inner plexiform layer (GCIPL) thickness, parameters that show distinctive profiles between papilledema and congenital disc anomalies. Longitudinal or baseline changes in pRNFL, ONHV and BMO have demonstrated high discriminatory power, particularly in mild optic disc elevation (Frisen grades I and II). OCT can also directly visualize optic disc drusen as hyper reflective deposits, aiding in identification of pseudopapilledema [6]. Optic disc swelling may occur because of many etiologies, including true or pseudopapilledema. Determining effective and accurate differential diagnostic criteria in these cases will prevent unnecessary examinations and procedures during the diagnosis [9]. Head-to-head studies comparing ocular ultrasonography and SD-OCT highlight complementary roles for these modalities in clinical practice. OCT provides superior spatial resolution for quantitative retinal layer analysis, while ultrasonography excels in detecting retrobulbar nerve and sheath alterations. The integration of clinical assessment, ocular ultrasonography and SD-OCT markedly enhances the sensitivity and specificity of diagnosing papilledema, optimally guiding further investigations such as magnetic resonance imaging and neuroimaging reserved for ambiguous or high-risk presentations [10]. Therefore, it is of interest to assess ocular ultrasonography and SD-OCT as complementary, noninvasive modalities for accurately differentiating Grade I-II papilledema from pseudopapilledema, to facilitate timely neuroimaging and management of suspected raised intracranial pressure while avoiding unnecessary invasive procedures.

Materials and Methods:

The current cross-sectional observational study titled Ocular Ultrasonography and Spectral Domain Optical Coherence Tomography to Differentiate Grade I and II Papilledema vs Pseudopapilledema in Clinically Diagnosed Optic Disc Elevation was done in the month of September 2022 to February 2024 at the Neuro-ophthalmology Clinic, Department of Ophthalmology, Shyam Shah Medical College, Rewa. The aim was to make a comparison between the diagnostic sensitivity of ocular ultrasonography and SD-OCT parameters in the distinction of early-grade papilledema versus pseudopapilledema. Sixty patients who fit the selection criteria were enrolled.

Study design:

Observational study which is cross sectional.

Selection of cases:

Those patients who had optic disc elevation in fundus examination were included. According to the Modified Frisen Grading System,

The cases were divided into following categories:

- [1] Grade I papilledema -sensitive C-shaped disc edema halo with intact temporal margin.
- [2] Grade II papilledema - peripheral halo of edema that is indicative of low grade papilledema.
- [3] Pseudo papilledema - druse of optic disc, tilted optic disc, optic disc hypoplasia.

Inclusion criteria:

- [1] Clinical diagnosis of Grade I and II papilledema.
- [2] Cases with pseudo papilledema presentation of fundus examination.

Exclusion criteria:

- [1] Age below 18 years.
- [2] Hypertensive or diabetic retinopathy.
- [3] Toxic/trumbo optic neuropathies.
- [4] Grade > II Papilledema on Modified Frisen Grading.

Data collection:

All the participants provided informed consent in writing upon being informed about the aim of the study. An elaborate demographic history, medical history and ophthalmic symptoms were noted. All patients were thoroughly systemically and ocularly assessed.

Ophthalmic evaluation:

Standardized ophthalmic examination was done on all subjects enrolled and this included: Snellen chart Best Corrected Visual Acuity (BCVA), Intraocular Pressure (IOP) by applanation tonometer of Goldman. Slit-lamp biomicroscopy of anterior part, lens and vitreous. Fundus examination and after pharmacologic dilation Fundus examination and photography with slit-lamp

using Direct and indirect ophthalmoscopy with Volk 90D lens. The Modified Frisen Grading System was used in recording and grading disc margin, color, cupping and vessel pattern, as well as optic disc elevation. A Topcon TRC-50DX fundus camera was used to take fundus photographs. Additional Investigations all participants underwent: Perimetry (Humphrey Field Analyzer), color vision, contrast sensitivity, Amsler grid and color desaturation, Optic nerve head ocular ultrasound, RNFL and optic nerve head Spectral Domain Optical Coherence Tomography (SD-OCT), MRI brain and orbit MR venography to rule out intracranial etiology, Lumbar puncture accompanied by measurement of the underlying pressure in the CSF and a biochemical analysis where necessary.

Results:

The current study included 60 patients, divided into two groups of 30 patients each: one for papilledema and one for pseudopapilledema. The average age of patients with papilledema was 35.33 ± 12.82 years, while that of the pseudopapilledema group was 40.67 ± 13.16 years; females were the majority in both groups. The papilledema group had a mean BMI of 28.2 ± 4.9 , which was much higher than the pseudopapilledema group's mean BMI of 23.2 ± 4.5 ($p < 0.01$). This group also had a higher percentage of overweight and obese people. The majority of patients were aged 18 to 30 years, with a smaller percentage of cases occurring in individuals over 60 years (**Table 1**). Clinically, headache was the most prevalent presenting symptom in papilledema (80%), succeeded by asthenopia, transient visual obscuration and nausea. Most people in both groups still had good vision, but the papilledema group had slightly better average logMAR scores. Patients with papilledema had much higher intraocular pressure (16.3 ± 2.9 mmHg) than those with pseudopapilledema (14.9 ± 1.5 mmHg, $p = 0.0012$) (**Table 2**). Ocular ultrasonography and SD-OCT results exhibited unique patterns across groups. The average optic nerve sheath diameter (ONSD) was significantly greater in cases of papilledema (mean 4.6 ± 0.6 mm) than in those of pseudopapilledema (mean 3.1 ± 0.5 mm, $p < 0.001$). In papilledema, the RNFL thickness and optic nerve head volume on SD-OCT were significantly higher, whereas the GCIPL measurements were lower. The crescent sign and positive 30°C test were helpful in telling the two conditions apart (**Table 3**). An evaluation of functional vision indicated that 40% of eyes with papilledema exhibited an enlargement of the blind spot, whereas no such enlargement was observed in eyes with pseudopapilledema. Contrast sensitivity and colour desaturation abnormalities were more evident in cases of papilledema (**Table 4**). In terms of diagnostic effectiveness, SD-OCT had a higher sensitivity for finding papilledema (86.7%) than ultrasonography (81.7%). However, both tests had similar specificity and predictive values. Neuroimaging results corroborated clinical diagnoses in most cases, with space-occupying lesions, elevated intracranial pressure and venous sinus abnormalities commonly observed in papilledema (**Table 5**).

Table 1: Demographic characteristics of patients

Parameter	Papilledema (n=30)	Pseudopapilledema (n=30)	p value
Age (years), mean ± SD	35.33 ± 12.82	40.67 ± 13.16	0.08
Age group 18-30 yrs, n (%)	10 (33.3)	10 (33.3)	-
Age group >60 yrs, n (%)	0 (0)	4 (13.3)	-
Male, n (%)	11 (36.7)	10 (33.3)	0.80
Female, n (%)	19 (63.3)	20 (66.7)	-
BMI, mean ± SD	28.2 ± 4.9	23.2 ± 4.5	0.0036
Overweight/Obesity, n (%)	23 (76.7)	8 (26.7)	<0.01

Table 2: Clinical presentation and visual function

Clinical/Visual Parameter	Papilledema (n=30)	Pseudopapilledema (n=30)	p value
Headache, n (%)	24 (80)	11 (36.7)	0.004
Transient visual obscuration, n (%)	9 (30)	3 (10)	0.034
Nausea, n (%)	10 (33.3)	3 (10)	0.005
Pulsatile tinnitus, n (%)	8 (26.7)	0 (0)	-
Best corrected VA (logMAR), mean ± SD	0.06 ± 0.009	0.13 ± 0.04	-
BCVA ≥6/9, n (%)	28 (93.3)	26 (86.7)	-
Intraocular Pressure (mmHg), mean ± SD	16.3 ± 2.9	14.9 ± 1.5	0.0012

Table 3: Ocular Imaging Findings (Ultrasound & OCT)

Parameter	Papilledema (n=60 eyes)	Pseudopapilledema (n=60 eyes)	p value
ONSD >3.3 mm, n (%)	54 (90)	12 (20)	<0.001
30°C reduction test positive, n (%)	49 (81)	5 (8.3)	<0.001
Crescent sign, n (%)	26 (43.3)	0 (0)	<0.001
Optic disc drusen, n (%)	0 (0)	32 (53.3)	<0.001
RNFL thickness (µm), mean ± SD	178 ± 23.4	128 ± 27.4	<0.001
BMO (µm), mean ± SD	1764 ± 210	1532 ± 196	<0.001
ONHV (mm ³), mean ± SD	6.34 ± 0.25	4.13 ± 0.3	<0.001
GCIPL thickness (µm), mean ± SD	66.69 ± 2.73	71.93 ± 4.50	<0.001
MRW (µm), mean ± SD	576 ± 54.7	458.9 ± 45.2	<0.001

Table 4: Functional and perimetric tests

Test	Papilledema	Pseudopapilledema	p value
Enlargement of blind spot, n (%)	24 (40)	0	0.018
Peripheral generalized suppression, n (%)	2 (3.3)	12 (20)	0.391
Color vision abnormality, n (%)	16 (26.7)	8 (13.3)	0.333
Contrast sensitivity abnormal, n (%)	20 (33.3)	0 (0)	0.0018
Amsler grid abnormal, n (%)	8 (13.3)	2 (3.3)	0.350
Color desaturation abnormal, n (%)	24 (40)	4 (6.7)	0.006

Table 5: Diagnostic effectiveness of imaging

Modality	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)
Ocular ultrasonography (Papilledema)	81.7	80	80.3	81.4
Ocular ultrasonography (Pseudo-papilledema)	71.7	81.4	79.6	73.8
SD-OCT (Papilledema)	86.7	75	77.6	84.9
SD-OCT (Pseudo-papilledema)	65	77	83	71
MRI/MRV abnormal findings in papilledema (any)	66.7%	-	-	-

The average age of patients with papilledema was 35.33 ± 12.82 years, while that of the pseudopapilledema group was 40.67 ± 13.16 years; females were the majority in both groups which is corresponds with the finding of Sekhri *et al.* [11] and Rosa *et al.* [12] in their study also preponderance of female gender is present. While the study done by Carta *et al.* [13] shown contrast with this study where gender distribution is equal. The observed greater retinal nerve fiber layer (RNFL) thickness and optic nerve head volume in papilledema compared to pseudopapilledema are consistent with the results reported by Bassi and Mohana [10] who demonstrated significantly thicker peripapillary RNFL in all quadrants in papilledema patients except the temporal quadrant, while pseudopapilledema cases exhibited localized thickening or normal RNFL values. Similar observations were reported by Fard *et al.* [14] who described characteristic hyper reflective sub retinal masses representing optic disc drusen in *pseudo papilledema*, aiding in distinction from

true disc edema. The higher optic nerve sheath diameter (ONSD) measured on ocular ultrasonography in papilledema compared to pseudopapilledema in the present study (4.6 ± 0.6 mm vs. 3.1 ± 0.5 mm) corroborates previous studies, such as one by Saenz *et al.* [7] which demonstrated mean ONSD of 5.4 ± 0.6 mm in papilledema and 4.0 ± 0.3 mm in pseudopapilledema (p < 0.0001). These structural parameters strongly support the diagnostic usefulness of ultrasonography for detecting raised intracranial pressure. The higher mean BMI and predominance of overweight or obese individuals in the papilledema group further support the role of obesity as a predisposing factor for idiopathic intracranial hypertension (IIH). Szewka *et al.* [15] found a strong correlation between elevated BMI and severity of papilledema, where each 10-unit increase in BMI increased the odds of severe visual loss by 1.4-fold. Similarly, weight reduction has been associated with improved visual outcomes in IIH patients, further confirming the pathophysiological link

between obesity and raised intracranial pressure. Functionally, headache, transient visual obscuration and enlarged blind spots were more common in papilledema, consistent with findings of previous series describing these symptoms as characteristic clinical features of raised intracranial pressure. In terms of diagnostic yield, SD-OCT showed higher sensitivity compared to ultrasonography in detecting papilledema, similar to the findings of Sibony *et al.* [16] who emphasized that quantitative parameters such as RNFL and GCIPL measurements on SD-OCT provide high diagnostic accuracy and are valuable for differentiating true edema from pseudopapilledema. These observations affirm the instrumental advantage of SD-OCT as a first-line tool in the evaluation of optic disc elevation, supported by concurrent ultrasonographic and neuroimaging assessments for definitive diagnosis.

Conclusion:

Ocular ultrasonography with SD-OCT is effective in differentiating Grade I-II papilledema from pseudopapilledema based on structural biomarkers such as ONSD, pRNFL, ONH volume and GCIPL. The crescent sign and a positive 30°C test are key indicators of papilledema, whereas optic disc drusen are indicative of pseudopapilledema. SD-OCT was slightly more sensitive than ultrasonography, supporting its role as a primary modality complemented by ultrasound and neuroimaging. Early differentiation helps ensure timely management of elevated intracranial pressure and avoids unwarranted invasive procedures in pseudopapilledema.

References:

[1] <https://www.ncbi.nlm.nih.gov/books/NBK538295/>

- [2] Carter SB *et al.* *Eye (London)*. 2014 **28**:1425. [PMID: 25190532].
- [3] Farazdaghi MK *et al.* *Journal of Neuro-Ophthalmology*. 2021 **41**:488. [PMID: 33870950]
- [4] El-Gendy RS *et al.* *International Ophthalmology*. 2024 **44**:272. [PMID: 38916684].
- [5] Jivraj I *et al.* *Journal of Neuro-Ophthalmology*. 2021 **41**:e509 [PMID: 32956225].
- [6] Hata M & Miyamoto K. *Neuro-Ophthalmology*. 2017 **41**:187. [PMID: 29344057].
- [7] Saenz R *et al.* *Optometry and Vision Science*. 2017 **94**:1081. [PMID: 29120977].
- [8] Bouthour W *et al.* *Neuro-Ophthalmology*. 2023 **47**:177. [PMID: 37434667].
- [9] Ray HJ *et al.* *Journal of Neuro-Ophthalmology*. 2024. [PMID: 38502219].
- [10] Bassi ST & Mohana KR. *Indian Journal of Ophthalmology*. 2014 **62**:1146. [PMID: 25579359].
- [11] Sekhri R *et al.* *Scientific Reports*. 2025 **15**:24847. [PMID: 40640273].
- [12] Rosa N *et al.* *Journal of Clinical Medicine*. 2022 **11**:3715. [PMID: 35806999].
- [13] Carta A *et al.* *PLoS One*. 2018 **13**:e0208145. [PMID: 30496251].
- [14] Fard MA *et al.* *Investigative Ophthalmology & Visual Science* 2019 **60**:168. [PMID: 30640969].
- [15] Szewka AJ *et al.* *Journal of Neuro-Ophthalmology* 2013 **33**:4. [PMID: 22217456].
- [16] Sibony PA *et al.* *Journal of Neuro-Ophthalmology*. 2021 **41**:77. [PMID: 32909979].

Caveat Emptor is applicable among the literate community where required and possible. The publisher, its journal, editors and the internal/external reviewers take adequate steps to check, evaluate, correct, edit, revise and improve content where possible and required.