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Assessment of Optic Disc Swelling (Papilledema) in Patients with Raised Intracranial Pressure and its Correlation with Neurological Findings: A Cross-Sectional Study

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ABSTRACT

Objective: To determine the frequency of papilledema among patients with raised intracranial pressure by using the Frisén grading scale.

Materials & Methods: A cross-sectional study was conducted among 198 adult patients with suspected or documented raised intracranial pressure at the University of Lahore Teaching Hospital, Lahore, Pakistan, from March to August 2026. Demographic, clinical, neurological, ophthalmological, and neuroimaging data were collected using a structured proforma. Papilledema was graded using the Frisén scale (Grades 0–5), with fundus photography and OCT used when available. Data were analyzed using IBM SPSS Statistics version 27. Descriptive statistics, chi-square or Fisher's exact tests, Spearman's correlation, and multivariable logistic regression were used as appropriate. Statistical significance was set at p less than 0.05, with 95% confidence intervals reported where applicable. Ethical approval, informed consent, and patient confidentiality were maintained.

Results: Among 198 patients, the largest age group was 31–45 years (36.4%), with a slight male predominance (54.5%). Papilledema was present in 136 (68.7%) patients, with Grade 2 being the most frequent. Headache was the predominant symptom (81.3%), followed by nausea or vomiting (57.1%) and blurred vision (50.0%). Motor weakness (28.3%) and sixth cranial nerve palsy (26.8%) were the most common neurological abnormalities. Serious neurological findings were more frequent among patients with higher papilledema grades (85.5%) than those with lower grades (36.4%). ROC analysis showed better discrimination for Frisén grading (AUC = 0.762) than for papilledema presence or absence alone (AUC = 0.654), suggesting that grading severity may provide additional clinical information about neurological involvement.

Conclusion: Papilledema was present in 68.7% of patients with raised intracranial pressure. Higher Frisén grades were associated with more frequent neurological abnormalities. Frisén grading demonstrated better discrimination of neurological outcomes than papilledema presence alone, highlighting its value in comprehensive clinical assessment.

Introduction

Raised intracranial pressure (ICP) is a clinically significant neurological condition that occurs when pressure within the cranial cavity increases beyond normal physiological limits. It may develop due to intracranial space-occupying lesions, cerebral edema, hydrocephalus, intracranial hemorrhage, cerebral venous sinus thrombosis, central nervous system infections, or idiopathic intracranial hypertension (IIH). If not diagnosed and managed promptly, sustained elevation of ICP may result in optic nerve damage, visual impairment, neurological deterioration, and potentially life-threatening complications [1]. Early recognition of clinical and ophthalmological indicators is therefore essential for appropriate diagnosis and management.Papilledema refers specifically to optic disc swelling caused by raised intracranial pressure and typically affects both eyes. Increased cerebrospinal fluid pressure surrounding the optic nerve interferes with axoplasmic transport at the optic nerve head, resulting in swelling of the optic disc [2,3]. Clinical features include blurred disc margins, optic disc elevation, venous congestion, hyperemia, peripapillary hemorrhages, and obscuration of retinal blood vessels. The severity of papilledema can be assessed using the Frisén grading scale, which categorizes optic disc swelling from grade 0 to grade 5. The degree of swelling may provide useful information regarding disease severity, although it does not always correspond directly to the measured ICP or the degree of neurological impairment [4,5].

The neurological manifestations of raised ICP vary according to its underlying cause, duration, and severity. Headache is among the most frequently reported symptoms and may be accompanied by nausea, vomiting, transient visual obscurations, diplopia, altered consciousness, seizures, or focal neurological deficits [6]. Sixth cranial nerve palsy may occur because of the vulnerability of the abducens nerve to increased intracranial pressure. The presence of additional cranial nerve abnormalities, motor weakness, sensory deficits, or altered mental status may indicate an underlying structural or vascular neurological disorder requiring urgent investigation. Ophthalmological assessment is an important component of the clinical evaluation of patients with suspected raised ICP [7,8]. Fundoscopy, visual acuity testing, pupillary examination, visual field assessment, fundus photography, and optical coherence tomography (OCT) can help identify and quantify optic disc swelling. Neuroimaging, particularly magnetic resonance imaging (MRI) with magnetic resonance venography (MRV), is useful for identifying intracranial masses, hydrocephalus, cerebral venous sinus thrombosis, and other potential causes. When appropriate and after imaging has excluded contraindications, lumbar puncture may be performed to assess cerebrospinal fluid opening pressure and composition. Despite the clinical importance of papilledema, its relationship with individual neurological findings may vary considerably between patients [9]. Some patients demonstrate substantial optic disc swelling with relatively preserved visual acuity, whereas others may present with significant neurological abnormalities and minimal or absent papilledema. Systematic assessment of papilledema severity alongside neurological examination may improve clinical risk stratification and support timely referral for further investigation [10].

Therefore, this study aims to assess the prevalence and severity of optic disc swelling in patients with raised intracranial pressure and to determine its correlation with neurological findings. The study also evaluates the relationship between papilledema grades, presenting symptoms, cranial nerve abnormalities, altered consciousness, focal neurological deficits, and relevant neuroimaging findings.

Study Objectives

1. To determine the frequency of papilledema among patients with raised intracranial pressure.
2. To assess the severity of optic disc swelling using the Frisén grading scale.

Materials And Methods

A cross-sectional study was designed to assess optic disc swelling in 198 adult patients with clinically suspected or documented raised intracranial pressure at the neurology and ophthalmology departments of University of Lahore Teaching Hospital, Lahore, Pakistan from March 2026 to August 2026. Consecutive sampling was proposed, and the study duration was to be defined according to the actual recruitment dates. Patients with evidence of raised intracranial pressure who underwent neurological and ophthalmological assessments were included, while those with alternative causes of optic disc swelling, pre-existing optic nerve disorders, incomplete records, or an unconfirmed diagnosis of raised intracranial pressure were excluded. Demographic characteristics, presenting symptoms, medical history, suspected etiology, neuroimaging findings, and neurological signs were recorded using a structured data collection form. Neurological assessment included headache, nausea, vomiting, diplopia, seizures, level of consciousness, cranial nerve abnormalities, motor weakness, and sensory deficits, with the Glasgow Coma Scale recorded where available. Ophthalmological assessment included visual acuity, pupillary responses, ocular movements, visual fields, and dilated fundus examination.

Optic disc swelling was graded using the Frisén scale from grade 0 to grade 5, with fundus photography and optical coherence tomography used when available. Raised intracranial pressure was evaluated through clinical findings, CT or MRI of the brain, MR venography where indicated, and cerebrospinal fluid opening-pressure measurements when clinically appropriate and safe. Data were analyzed using IBM SPSS Statistics version 27. Categorical variables were presented as frequencies and percentages, while continuous variables were summarized as means and standard deviations or medians and interquartile ranges, as appropriate. Associations between papilledema severity and neurological findings were evaluated using the chi-square test or Fisher's exact test, while Spearman's correlation and multivariable logistic regression were used where appropriate. A two-sided p-value of less than 0.05 was considered statistically significant, and 95% confidence intervals were reported where applicable. Ethical approval, informed consent, and confidentiality safeguards were to be ensured in accordance with institutional research guidelines.

Results

Among the 198 patients, the largest proportion belonged to the 31–45 years age group, comprising 72 (36.4%) patients, followed by 51 (25.8%) patients aged 46–60 years and 48 (24.2%) patients aged 18–30 years. The smallest proportion was observed among patients older than 60 years, accounting for 27 (13.6%) cases. Regarding sex distribution, males constituted 108 (54.5%) patients, while females accounted for 90 (45.5%). Overall, the study population showed a slight male predominance, with most patients belonging to the 31–45 years age group (Table 1).

Table 1: Demographic characteristics of the study population (n = 198)

Variable	Frequency (n)	Percentage (%)
Age group (years)		
18–30	48	24.2
31–45	72	36.4
46–60	51	25.8
>60	27	13.6
Sex		
Male	108	54.5
Female	90	45.5
Total	198	100.0

Among the 198 patients, papilledema was absent (Grade 0) in 62 (31.3%) patients. Mild papilledema (Grade 1) was observed in 28 (14.1%) patients, while 39 (19.7%) had moderate papilledema (Grade 2). Marked papilledema (Grade 3) was identified in 34 (17.2%) patients, severe papilledema (Grade 4) in 23 (11.6%) patients, and very severe papilledema (Grade 5) in 12 (6.1%) patients. Overall, papilledema of some degree was present in 136 (68.7%) patients, with moderate papilledema being the most frequent grade among affected patients (Table 2).

Table 2: Distribution according to Frisén Grading

Papilledema Grade	Frequency	Percentage (s)
Grade 0: absent	62	31.3
Grade 1: mild	28	14.1
Grade 2: moderate	39	19.7
Grade 3: marked	34	17.2
Grade 4: severe	23	11.6
Grade 5: very severe	12	6.1
Total	198	100.0

Among the 198 patients, headache was the most common clinical feature, reported in 161 (81.3%) patients, followed by nausea or vomiting in 113 (57.1%) patients. Blurred vision was observed in 99 (50.0%) patients, while transient visual obscurations were reported in 67 (33.8%) patients. Diplopia was present in 65 (32.8%) patients, whereas seizures were the least common clinical feature, occurring in 27 (13.6%) patients. Overall, headache and nausea or vomiting were the predominant presenting symptoms among the study participants (Table 3).

Table 3: Clinical features of Papilledema

Clinical feature	Frequency (n)	Percentage (%)
Headache	161	81.3
Nausea or vomiting	113	57.1
Blurred vision	99	50.0
Transient visual obscurations	67	33.8
Diplopia	65	32.8
Seizures	27	13.6

Among the 198 patients, motor weakness was the most common neurological abnormality, observed in 56 (28.3%) patients, followed by sixth cranial nerve palsy in 53 (26.8%) patients. Altered consciousness was reported in 32 (16.2%) patients, while seizures occurred in 27 (13.6%) patients. Overall, 106 (53.5%) patients presented with at least one of the specified serious neurological findings, indicating that more than half of the study population had clinically significant neurological abnormalities (Table 4).

Table 4: Neurological abnormalities in the study population

Neurological finding	Frequency (n)	Percentage (%)
Sixth cranial nerve palsy	53	26.8
Motor weakness	56	28.3
Altered consciousness	32	16.2
Seizures	27	13.6
At least one of the above serious neurological findings	106	53.5

Neurological abnormalities were more frequent among patients with higher papilledema grades (Grades 3–5) than among those with lower grades (Grades 0–2). Sixth cranial nerve palsy was observed in 35 (50.7%) patients with higher-grade papilledema compared with 18 (14.0%) patients with lower-grade papilledema. Similarly, motor weakness was present in 34 (49.3%) versus 22 (17.1%) patients, while altered consciousness occurred in 20 (29.0%) versus 12 (9.3%) patients, respectively. Seizures were reported in 12 (17.4%) patients in the higher-grade group and 15 (11.6%) patients in the lower-grade group. Overall, at least one serious neurological finding was present in 59 (85.5%) patients with Grades 3–5 papilledema, compared with 47 (36.4%) patients with Grades 0–2. These findings suggest that higher papilledema grades were associated with a greater burden of neurological abnormalities, although statistical testing would be required to establish the significance of these associations (Table 5).

Table 5: Neurological findings according to papilledema grade group

Neurological finding	Grades 0–2 (n = 129)	Grades 3–5 (n = 69)
Sixth cranial nerve palsy	18 (14.0%)	35 (50.7%)
Motor weakness	22 (17.1%)	34 (49.3%)
Altered consciousness	12 (9.3%)	20 (29.0%)
Seizures	15 (11.6%)	12 (17.4%)
At least one serious neurological finding	47 (36.4%)	59 (85.5%)

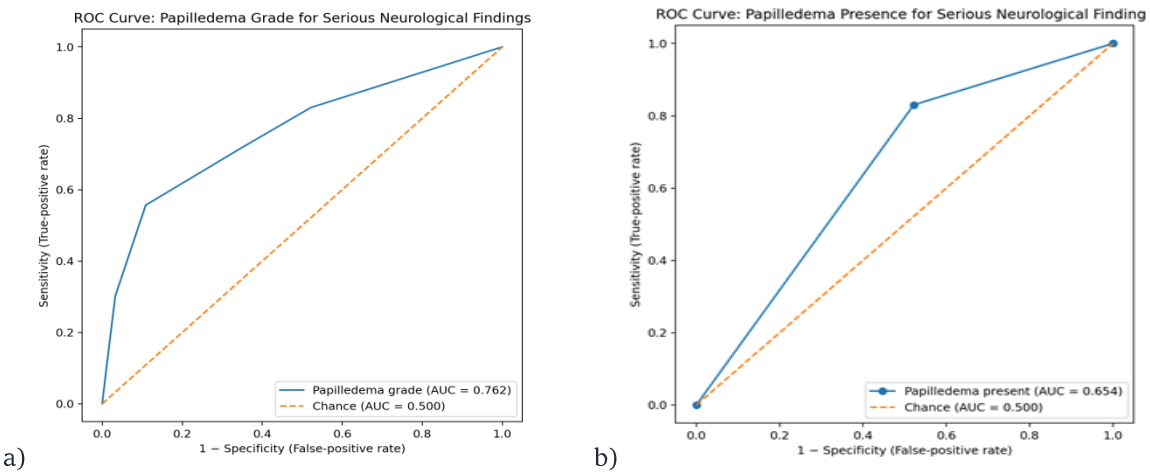


Figure: a)ROC curve of Papilledema Grade for Serious Neurological Findings (b)ROC curve of Papilledema presence for serious Neurological Findings

ROC curve analysis showed that the Frisén papilledema grade (0–5) had an area under the curve (AUC) of 0.762 for predicting the composite neurological outcome, indicating moderate discriminatory ability. In comparison, the presence versus absence of papilledema yielded an AUC of 0.654, demonstrating limited discriminatory performance. These findings suggest that grading the severity of papilledema may provide better discrimination of neurological outcomes than simply identifying its presence or absence.

Table 6: Comparison of ROC–AUC Results

Predictor	Outcome	AUC	Interpretation
Frisén grade, 0–5	Composite neurological outcome	0.762	Moderate discrimination
Papilledema present versus absent	Composite neurological outcome	0.654	Limited discrimination

Discussion

The present study assessed the prevalence and severity of papilledema and its association with neurological findings among 198 patients with raised intracranial pressure. Papilledema was present in 136 (68.7%) patients, while 62 (31.3%) had no papilledema. The principal findings were the predominance of headache, the relatively high frequency of visual symptoms, the increased burden of neurological abnormalities among patients with higher papilledema grades, and the better discriminatory performance of Frisén grading compared with the simple presence or absence of papilledema. These findings support the importance of integrating ophthalmological examination with neurological assessment in patients suspected of having raised intracranial pressure. In the present study, the largest proportion of patients belonged to the 31–45 years age group, accounting for 72 (36.4%) participants, followed by the 46–60 years group with 51 (25.8%). Males constituted 108 (54.5%) patients, while females accounted for 90 (45.5%). This relatively balanced sex distribution may reflect the inclusion of patients with different causes of raised intracranial pressure rather than a population restricted to idiopathic intracranial hypertension (IIH). In contrast, a study examining intracranial pressure in patients with IIH by Funnell et al.,[11] included 36 patients, of whom 35 were female and one was male, with a mean age of 32.5 ± 9.49 years. The marked female predominance in that study is consistent with the recognized demographic pattern of IIH. The difference from the present study may be attributable to differences in study populations, underlying etiologies, referral patterns, and inclusion criteria. Therefore, demographic findings from an IIH-specific cohort should not be directly generalized to all patients with raised intracranial pressure.

Papilledema was identified in 68.7% of the present study population, indicating that approximately two-thirds of patients had clinically detectable optic disc swelling. Grade 2 papilledema was the most frequent grade among affected patients, occurring in 39 (19.7%) of all participants, followed by Grade 3 in 34 (17.2%) and Grade 1 in 28 (14.1%). Severe and very severe papilledema, corresponding to Grades 4 and 5, were observed in 23 (11.6%) and 12 (6.1%) patients, respectively. The modified Frisén scale is widely used to classify papilledema according to the extent of optic disc elevation, blurring of the disc margins, and obscuration of retinal vessels. Its progressive grades provide a standardized approach to documenting the severity of optic disc swelling and monitoring changes over time. In the Idiopathic Intracranial Hypertension Treatment Trial, Wall et al.,[12] investigated that Grade 2 was also the most common papilledema grade at baseline, providing a qualitative point of agreement

with the present findings. However, the populations and eligibility criteria differed, so the distributions cannot be interpreted as directly equivalent. The finding that 62 (31.3%) patients had no papilledema despite suspected or established raised intracranial pressure is also clinically important. Absence of optic disc swelling does not independently exclude raised intracranial pressure. In a cohort of 36 patients with IIH undergoing continuous intracranial pressure monitoring, Warden et al. found significantly higher median 24-hour intracranial pressure in patients with papilledema than in those without it, although the pressure ranges varied.

Headache was the most common symptom in the present study, affecting 161 (81.3%) patients, followed by nausea or vomiting in 113 (57.1%). Blurred vision was reported in 99 (50.0%) patients, transient visual obscurations in 67 (33.8%), and diplopia in 65 (32.8%). Seizures occurred in 27 (13.6%) patients. The predominance of headache is consistent with established clinical descriptions of raised intracranial pressure, in which headache may occur alongside nausea, vomiting, transient visual disturbances, and diplopia. The frequency of headache in the present study is also broadly consistent with its recognized prominence in IIH. However, the frequency of individual visual symptoms can vary substantially according to the underlying cause, disease duration, severity of intracranial pressure elevation, and patient selection. Transient visual obscurations may indicate transient disturbances in optic nerve function, while diplopia can result from sixth cranial nerve dysfunction investigated by Lowe et al.,[13] The relatively high frequency of blurred vision in the present population emphasizes the importance of documenting visual acuity, visual fields, pupillary responses, and optic disc appearance rather than relying on headache alone.

An important finding was the greater frequency of neurological abnormalities among patients with higher papilledema grades (Grades 3–5). Sixth cranial nerve palsy was observed in 35 (50.7%) patients in the higher-grade group, compared with 18 (14.0%) in the lower-grade group. Motor weakness was present in 34 (49.3%) versus 22 (17.1%), while altered consciousness occurred in 20 (29.0%) versus 12 (9.3%), respectively. Furthermore, at least one serious neurological finding was present in 59 (85.5%) patients with higher-grade papilledema, compared with 47 (36.4%) patients with Grades 0–2. These findings suggest that higher-grade papilledema was associated with a greater neurological disease burden in this study population. The association is clinically plausible because Rigi et al.,[14] concluded that increased intracranial pressure can affect the sixth cranial nerve, while focal neurological deficits and altered consciousness may indicate an underlying structural, vascular, infectious, or other intracranial disorder. Clinical guidance emphasizes that sixth cranial nerve palsy can occur with raised intracranial pressure, whereas additional focal neurological abnormalities should prompt careful investigation for secondary intracranial pathology. Nevertheless, the relationship should be interpreted cautiously. Papilledema grade reflects optic disc swelling rather than providing a direct measurement of intracranial pressure or overall neurological injury. The American Academy of Ophthalmology notes that the severity of papilledema does not necessarily correspond to the degree of visual loss at presentation. Similarly, the present findings do not establish that increasing papilledema severity independently causes neurological abnormalities. Formal statistical comparisons and adjustment for underlying etiology, neuroimaging findings, and other confounders would be necessary to determine whether the association remains significant after adjustment. Seizures were an exception to the general pattern: they occurred in 15 (11.6%) patients with Grades 0–2 and 12 (17.4%) patients with Grades 3–5. Although the proportion was numerically higher in the latter group, the difference was smaller than those observed for sixth cranial nerve palsy, motor weakness, and altered consciousness. Seizures may depend more strongly on the underlying intracranial pathology than on the severity of optic disc swelling alone.

ROC analysis showed that the Frisén grade, treated as an ordinal predictor, achieved an AUC of 0.762 for the composite neurological outcome, indicating moderate discrimination. In comparison, the binary classification of papilledema as present or absent yielded an AUC of 0.654, indicating weaker discrimination. The difference of 0.108 suggests that grading the extent of optic disc swelling may provide more useful information about neurological status than recording its presence alone. This finding supports the use of standardized papilledema grading as part of a comprehensive clinical assessment. Scott et al.,[15] demonstrated that the modified Frisén scale correlates with optical coherence tomography (OCT) measurements of retinal nerve fiber layer and total retinal thickness. In a study of 36 patients, the reported correlations between photographic Frisén grades and OCT measurements were 0.85 and 0.87, respectively. Such evidence supports the value of standardized grading for quantifying optic disc swelling, although it does not directly validate the AUC observed in the present study. The present AUC findings should therefore be considered preliminary evidence of discriminatory ability rather than proof of clinical predictive accuracy. Confidence intervals for both AUC estimates, a statistical comparison between the ROC curves, and external validation would strengthen the interpretation. In addition, the composite neurological outcome should be clearly defined, and the analysis should account for the ordinal nature of Frisén grades. Because this was a cross-sectional study, the analysis evaluates discrimination of concurrent neurological findings rather than prediction of future neurological deterioration.

Conclusion

Papilledema was present in 68.7% of patients, with headache being the most common symptom (81.3%). Higher papilledema grades were associated with more frequent neurological abnormalities. Frisén grading showed better discrimination of

neurological outcomes (AUC = 0.762) than papilledema presence or absence alone (AUC = 0.654). These findings emphasize the importance of standardized optic disc grading alongside neurological assessment and neuroimaging.

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