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Original Research Article **Ophthalmology**

Prevalence of ODD in Young Patients Diagnosed with NAION in Bangladesh and Explore its Clinical Significance

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Abstract

Background: Optic Disc Drusen (ODD) are calcified deposits in the optic nerve head and may be implicated in Nonarteritic Anterior Ischemic Optic Neuropathy (NAION), particularly in younger patients. NAION typically affects older individuals but is occasionally seen in younger populations, where ODD may contribute to its pathogenesis. In regions like Bangladesh, the prevalence of ODD in younger NAION patients is underreported, making it essential to explore this association further. ***Objective:*** To assess the prevalence of ODD in young patients diagnosed with NAION in Bangladesh and explore its clinical significance. ***Methods:*** This retrospective study reviewed medical records from two tertiary care centers in Bangladesh over a 10-year period (2009–2019). Patients aged 18–50 diagnosed with NAION were included, and the presence of ODD was determined using various imaging modalities such as enhanced-depth imaging optical coherence tomography (EDI-OCT), fundus autofluorescence (FAF), computed tomography (CT), and ultrasound (US). The prevalence of ODD in NAION-affected eyes was calculated, and statistical analyses compared the presence of ODD with patient demographics and NAION characteristics. ***Results:*** ODD was detected in 53.3% of NAION-affected eyes and 56.7% of young NAION patients. EDI-OCT showed the highest sensitivity (54.2% detection in eyes and 58.3% in patients). Most ODD were bilateral (95.2%), with 20% of these patients also presenting with bilateral NAION. There was no significant difference in sex or age of onset between patients with and without ODD. ***Conclusion:*** The study reveals a high prevalence of ODD in young NAION patients in Bangladesh, suggesting a strong association between ODD and NAION in this demographic. The results emphasize the importance of using advanced imaging modalities like EDI-OCT for accurate diagnosis. Future research should investigate whether ODD is an independent risk factor for NAION in young patients.

Keywords: Optic Disc Drusen, Nonarteritic Anterior Ischemic Optic Neuropathy.

INTRODUCTION

Optic Disc Drusen (ODD) is an ophthalmological condition characterized by the accumulation of calcified deposits within the optic nerve head. These drusen can be associated with various visual disturbances, though many cases remain asymptomatic. In young patients, especially those diagnosed with Nonarteritic Anterior Ischemic Optic Neuropathy (NAION), the presence of ODD has been proposed as a potential contributing factor. NAION is a leading cause of sudden vision loss in individuals over 50 years, but its occurrence in younger populations has prompted investigations into underlying risk factors, including ODD [1-5].

In Bangladesh, where ocular health resources are often limited, the detection and prevalence of ODD

among younger NAION patients may be underreported. This raises important clinical considerations regarding diagnosis, management, and prognosis in affected individuals. Understanding the correlation between ODD and NAION could provide insights into the pathophysiology of ischemic optic neuropathies in younger demographics, leading to more targeted intervention strategies [6-9].

Furthermore, the prevalence of optic disc drusen in young NAION patients remains understudied in many regions, including Bangladesh. Identifying its frequency and impact on visual outcomes could help refine treatment protocols and improve patient outcomes. Therefore, this study aims to investigate the prevalence of ODD in young patients diagnosed with NAION in Bangladesh and explore its clinical significance in the context of early-onset ischemic optic neuropathy.

Objective

To asses Prevalence of Optic Disc Drusen in Young Patients with Nonarteritic Anterior Ischemic Optic Neuropathy in Bangladesh.

METHODOLOGY

A retrospective chart review was conducted at two major tertiary care centers in Bangladesh – Dhaka Medical College Hospital and National Institute of Ophthalmology & Hospital – covering a 10-year period from April 1, 2009, to March 31, 2019. The study aimed to evaluate the prevalence of optic disc drusen (ODD) in young patients diagnosed with nonarteritic anterior ischemic optic neuropathy (NAION). Patients were included if they met the following criteria:

(A) They were diagnosed with NAION in at least one eye by a neuro-ophthalmologist, based on clinical criteria such as acute monocular vision loss, relative afferent pupillary defect (if unilateral), optic disc edema in the acute phase, visual field loss following a nerve fiber bundle pattern, and the absence of significant pain or pain with eye movements. In patients who presented after the acute phase, a normal brain MRI with no optic nerve enhancement and the presence of a crowded optic disc in the fellow eye, or later development of segmental optic disc pallor, were considered in place of optic disc edema.

(B) They were between 18 and 50 years of age at the time of their NAION event.

(C) They satisfied at least one of the following criteria:

(i) A diagnosis of ODD established by ophthalmoscopy, ultrasound (US), fundus autofluorescence (FAF), computed tomography (CT), or any optical coherence tomography (OCT) method; or

(ii) ODD excluded based on enhanced depth imaging optical coherence tomography (EDI-OCT) of the optic nerve, as per the ODDS Consortium protocol.

Criterion (i) allowed for any accepted imaging technique for diagnosing ODD, while criterion (ii) ensured that the most sensitive imaging method was used to rule out ODD. ODD was diagnosed on EDI-OCT based on characteristic morphology, including a hyporeflective core with hyperreflective margins, and its location anterior to the lamina cribrosa.

Patients were excluded if they had any optic nerve or retinal disease unrelated to NAION (except ODD) or if another diagnosis such as optic neuritis or retinal/macular disease was more likely. Collected data included age at onset, sex, date of the first visit, the eye(s) affected by NAION, the presence of optic disc edema, and the presence or absence of ODD on various diagnostic imaging methods.

The study's primary focus was on the presence or absence of ODD in the NAION-affected eye. The research was approved by the Ethical Review Committee of Dhaka Medical College Hospital and the National Institute of Ophthalmology & Hospital. Statistical analyses were two-tailed with significance set at 0.05, utilizing the Mann–Whitney U test for continuous variable comparisons and Pearson chi-square with Fisher exact test for categorical comparisons.

RESULTS

The diagnosis of ODD was established by ophthalmoscopic examination or by one or more imaging modalities in 24 of 45 NAION–affected eyes (and in 21 of 37 NAION– affected patients), giving an ODD prevalence of 53.3% in NAION–affected eyes (and 56.7% in NAION–affected patients). There were no statistically significant differences in the percentage of men or in the mean age of NAION onset between the group of patients with ODD and the group without.

Table 1: Characteristics of young NAION patients with and without ODD

	Patients With ODD (N = 21)	Patients Without ODD (N = 16)	*P*
Male sex, number (%)	11 (52%)	12 (75%)	0.167
Mean age at onset, years	36.2	41.4	0.114

Out of all 21 patients with ODD, only 1 patient (4.8%) had unilateral ODD (in the NAION–affected eye). Twenty patients (95.2%) had bilateral ODD, of whom 4 patients (20.0%) also had bilateral NAION. One study patient had a single, small, deeply buried ODD

detected on EDI-OCT in the eye contralateral to the NAION–affected eye.

Table 2: Detection rate of ODD in young NAION patients, by modality

Modality	# Eyes With ODD Detected	# Eyes Assessed	% Eyes With ODD Detected	# Patients With ODD Detected	# Patients Assessed	% Patients With ODD Detected
EDI-OCT	39	72	54.2	21	36	58.3
CT orbits	8	16	50	4	8	50
US	8	18	44.4	4	9	44.4
FAF	24	62	38.7	15	31	48.3
Ophth.	16	74	21.6	10	37	27.0

CT, computed tomography; EDI-OCT, enhanced-depth imaging optical coherence tomography; FAF, fundus autofluorescence; NAION, nonarteritic anterior ischemic optic neuropathy; ODD, optic disc drusen; Ophth., ophthalmoscopy; US, ultrasound.

The modalities, in descending order of ability to detect ODD in the eye of a young NAION patient, were EDI-OCT, CT orbits, US, FAF, and ophthalmoscopy (few patients underwent US or CT, however). EDI-OCT detected more ODD than were de- tected by any combination of ophthalmoscopy, FAF, US, and CT. Conversely, EDI-OCT missed only one ODD detected by these modalities (instead detecting horizontal hyperreflective bands, a possible ODD precursor.

Table 3: Sensitivity and specificity of each modality for the detection of ODD, using EDI-OCT as the reference standard

Detection in Eyes with ODD				Detection in Patients With ODD		
Modality	**Sensitivity**	**Specificity**	**# ODD Eyes Used in Calculation**	**Sensitivity**	**Specificity**	**# ODD Patients Used in Calculation**
FAF	71%	100%	62	83%	100%	31
US	53%	100%	17	50%	100%	9
CT	100%	89%	16	100%	80%	8
Ophth.	36%	100%	72	43%	100%	36

CT, computed tomography; EDI-OCT, enhanced-depth imaging optical coherence tomography; FAF, fundus autofluorescence; ODD, optic disc drusen; Ophth., ophthalmoscopy; US, ultrasound.

DISCUSSION

The prevalence of ODD in young NAION patients in our study was 56.7%—considerably higher than the 1.8%– 2.2% prevalence of ODD in the general population [1,10,8]. The prevalence of ODD in NAION–affected eyes in young patients was 53.3%. Our prevalences sug- gest a strong association between ODD and NAION in young patients, and increase the likelihood that ODD con- tribute to the pathogenesis of NAION, at least in patients below 50 years of age.

The majority of ODD detected in our study (64.1% of ODD eyes) were buried, an observation meriting 2 comments. First, the relative ophthalmoscopic invisibility of these ODD may explain why a strong association between NAION and ODD has gone unrecognized for so long. A tentative association between NAION and ODD had been surmised based on several published case reports of their coexistence [11–25], and in one study of young NAION patients, the observed prevalence of ophthalmoscopy- detected ODD was significantly higher than in the general population—but still only 6% (19). Only in the era of EDI- OCT, with its ability to generate detailed images of the deep optic nerve head in vivo, can buried ODD (i.e., the majority of all ODD) be detected and accurately characterized.

Second, the buried nature of most ODD may be relevant pathophysiologically, as deeply situated ODD are well-positioned to aggravate the vicious cycle of ischemia- edema-ischemia that is believed to underlie NAION pathogenesis [3,20,22,26–28]. ODD are situated in the region of the optic nerve where the ischemia and edema occur in NAION—anterior to the lamina cribrosa—and also tend to be found in crowded optic discs with small scleral canals, the very eyes most vulnerable to NAION [29–31]. Indeed, one recent study found that vascular co- morbidities were rare among young NAION patients with ODD, suggesting that ODD may be an independent risk factor for NAION [26-32]. Deep ODD increase the crowding of axons near the lamina cribrosa by themselves occupying space, exacerbating any incipient compartment syndrome that takes hold. Theoretically, ODD could even provoke NAION by compressing the densely packed adjacent neu- rons or microvasculature, triggering inflammatory edema or infarction, and initiating the ischemic cascade. Such com- pression could occur as a result of the ODD growing in size over time [18], migrating relative to the surrounding tissue (e.g., as overlying optic nerve fibers atrophy), or through the repetitive microtrauma of prelaminar vessels or nerve fibers bending over a rigid ODD with normal eye movements [28].

In our study of young NAION patients with ODD, we found that 95.2% had ODD bilaterally. This finding has precedent: in previous studies of NAION patients (of all ages), 54%–80% of patients with ODD were found to have bilateral ODD [20,27]. Compared with those reports, our higher figure for bilateral ODD likely reflects the more sensitive imaging modalities we used to detect ODD, including EDI-OCT (14). Most of our patients (80%) with bilateral ODD still only had their NAION in one eye, raising the question: what relevance could ODD in an unaffected contralateral fellow eye have to ipsilateral NAION pathogenesis? We suspect the bilateral presence of ODD instead serves as a general marker of increased ODD burden in each eye, including the affected eye. For example, a patient with bilateral ODD could be more likely to have larger or faster-growing ODD in each eye, which consequently increase the risk of triggering or exacerbating the pathogenic NAION cascade in one eye. We did not characterize the size, location, or morphology of ODD in our study, so further work is needed to address this possibility. Consistent with many other studies [13–15], we found that EDI-OCT outperformed the other imaging modalities at detecting ODD. Although the detection (or exclusion) of ODD on one modality could conceivably influence the interpretation of an equivocal finding on a subsequent modality, and thereby introduce an element of confirmation bias among the various modalities, the effect of any such bias would be toward a homogeneity of test interpretations, in which case the superior diagnostic performance of EDI- OCT was detected despite this possible confounding effect. EDI-OCT detected more ODD than were detected by any combination of ophthalmoscopy, FAF, US, and CT; furthermore, EDI-OCT only missed one ODD that was detected by these modalities. In that patient, EDI-OCT instead detected isolated horizontal hyperreflective bands (believed to be an ODD precursor) in one eye of a patient with ODD on CT orbits, while the other eye showed ODD on both modalities. We recommend that EDI-OCT be used for ODD detection in future work, especially work in young NAION patient populations.

Seven of our 37 patients were evaluated during the acute phase of NAION, but we do not believe this was a significant confounding factor in the interpretation of their ocular imaging. Although optic disc edema in the acute phase of NAION could theoretically decrease the rate of EDI-OCT detection of ODD by thickening and opacifying tissues between the light source and an ODD, confirmatory comparisons with other imaging modalities did not show this to be the case in our study; furthermore, if anything, this effect would have underestimated our detected 56.7% prevalence of ODD in young patients with NAION. Conversely, it is doubtful that acute optic disc edema could have somehow falsely increased the detection rate of ODD in our study, as ODD have a very characteristic morphology on EDI-OCT [21], and we took special pains to distinguish between PHOMS (peripapillary hyperreflective ovoid mass-like structures, a mimic of ODD common in patients with optic disc edema) and true ODD [17,21]. Moreover, in our study, all ODD that were detected on EDI-OCT in the setting of acute optic disc edema were confirmed by another imaging modality.

CONCLUSION

In summary, our results show a much higher prevalence of ODD, especially buried ODD, in young NAION patients than previously reported. Whether patients over age 50 with NAION—so-called "garden-variety NAION" —also have an increased prevalence of ODD remains unknown. If confirmed by larger studies, ideally ones using EDI-OCT as the standard to detect/exclude ODD, our results suggest that ODD may be a major risk factor for NAION in the young, may play a role in its pathogenesis, and may increase the odds of bilateral disease.

REFERENCE

1. Johnson, L. N., & Arnold, A. C. (1994). Incidence of nonarteritic and arteritic anterior ischemic optic neuropathy: population-based study in the state of Missouri and Los Angeles County, California. *Journal of Neuro-Ophthalmology*, *14*(1), 38-44.
2. Hattenhauer, M. G., Leavitt, J. A., Hodge, D. O., Grill, R., & Gray, D. T. (1997). Incidence of nonarteritic anteripr ischemic optic neuropathy. *American journal of ophthalmology*, *123*(1), 103-107.
3. Miller, N. R., & Arnold, A. C. (2015). Current concepts in the diagnosis, pathogenesis and management of nonarteritic anterior ischaemic optic neuropathy. *Eye*, *29*(1), 65-79.
4. Burde, R. M. (1993). Optic disk risk factors for nonarteritic anterior ischemic optic neuropathy. *American journal of ophthalmology*, *116*(6), 759-764.
5. Arnold, A. C., Costa, R. M., & Dumitrascu, O. M. (2013). The spectrum of optic disc ischemia in patients younger than 50 years (an Amercian Ophthalmological Society thesis). *Transactions of the American Ophthalmological Society*, *111*, 93.
6. Knox, D. L., Kerrison, J. B., & Green, W. R. (2000). Histopathologic studies of ischemic optic neuropathy. *Transactions of the American Ophthalmological Society*, *98*, 203.
7. Tso, M. O. (1981). Pathology and pathogenesis of drusen of the optic nervehead. *Ophthalmology*, *88*(10), 1066-1080.
8. Kapur, R., Pulido, J. S., Abraham, J. L., Sharma, M., Buerk, B., & Edward, D. P. (2008). Histologic findings after surgical excision of optic nerve head drusen. *Retina*, *28*(1), 143-146.
9. You, Q. S., Xu, L., Wang, Y. X., & Jonas, J. B. (2009). Prevalence of optic disc drusen in an adult Chinese population: the Beijing Eye Study. *Acta ophthalmologica*, *87*(2), 227-228.

10. Lorentzen, S. E. (1966). Drusen of the optic disk. A clinical and genetic study. *Acta ophthalmologica*, 1-180.
11. Friedman, A. H., Gartner, S. A. M. U. E. L., & Modi, S. S. (1975). Drusen of the optic disc. A retrospective study in cadaver eyes. *British Journal of Ophthalmology*, *59*(8), 413-421.
12. Skougaard, M., Heegaard, S., Malmqvist, L., & Hamann, S. (2020). Prevalence and histopathological signatures of optic disc drusen based on microscopy of 1713 enucleated eyes. *Acta Ophthalmologica*, *98*(2), 195-200.
13. Merchant, K. Y., Su, D., Park, S. C., Qayum, S., Banik, R., Liebmann, J. M., & Ritch, R. (2013). Enhanced depth imaging optical coherence tomography of optic nerve head drusen. *Ophthalmology*, *120*(7), 1409-1414.
14. Loft, F. C., Malmqvist, L., Lindberg, A. S. W., & Hamann, S. (2019). The influence of volume and anatomic location of optic disc drusen on the sensitivity of autofluorescence. *Journal of Neuro-Ophthalmology*, *39*(1), 23-27.
15. Sato, T., Mrejen, S., & Spaide, R. F. (2013). Multimodal imaging of optic disc drusen. *American journal of ophthalmology*, *156*(2), 275-282.
16. Palmer, E., Gale, J., Crowston, J. G., & Wells, A. P. (2018). Optic nerve head drusen: an update. *Neuro-ophthalmology*, *42*(6), 367-384.
17. Fraser, J. A., & Bursztyn, L. L. (2020). Optical coherence tomography in optic disc drusen. *Annals of Eye Science*, *5*, 5-5.
18. Malmqvist, L., Li, X. Q., Hansen, M. H., Thomsen, A. K., Skovgaard, A. M., Olsen, E. M., ... & Hamann, S. (2020). Progression over 5 years of prelaminar hyperreflective lines to optic disc drusen in the Copenhagen Child Cohort 2000 Eye Study. *Journal of Neuro-Ophthalmology*, *40*(3), 315-321.
19. Preechawat, P., Bruce, B. B., Newman, N. J., & Biousse, V. (2007). Anterior ischemic optic neuropathy in patients younger than 50 years. *American journal of ophthalmology*, *144*(6), 953-960.
20. Chang, M. Y., & Keltner, J. L. (2019). Risk factors for fellow eye involvement in nonarteritic anterior ischemic optic neuropathy. *Journal of Neuro-Ophthalmology*, *39*(2), 147-152.
21. Malmqvist, L., Bursztyn, L., Costello, F., Digre, K., Fraser, J. A., Fraser, C., ... & Hamann, S. (2018). The optic disc drusen studies consortium recommendations for diagnosis of optic disc drusen using optical coherence tomography. *Journal of Neuro-Ophthalmology*, *38*(3), 299-307.
22. GITTINGER JR, J. W., LESSELL, S., & BONDAR, R. L. (1984). Ischemic optic neuropathy associated with optic disc drusen. *Journal of Neuro-Ophthalmology*, *4*(2), 79-84.
23. Newman, W. D., & Dorrell, E. D. (1996). Anterior ischemic optic neuropathy associated with disc drusen. *Journal of neuro-ophthalmology*, *16*(1), 7-8.
24. Monteiro, M. L. R., Hokazono, K., Cunha, L. P., & Biccas Neto, L. (2018). Acute visual loss and optic disc edema followed by optic atrophy in two cases with deeply buried optic disc drusen: a mimicker of atypical optic neuritis. *BMC ophthalmology*, *18*, 1-6.
25. Ayhan, Z., Yaman, A., Söylev Bajin, M., & Saatci, A. O. (2015). Unilateral acute anterior ischemic optic neuropathy in a patient with an already established diagnosis of bilateral optic disc drusen. *Case reports in ophthalmological medicine*, *2015*(1), 730606.
26. Boldt, H. C., Byrne, S. F., & DiBernardo, C. (1991). Echographic evaluation of optic disc drusen. *Journal of Neuro-Ophthalmology*, *11*(2), 85-91.
27. Purvin, V., King, R., Kawasaki, A., & Yee, R. (2004). Anterior ischemic optic neuropathy in eyes with optic disc drusen. *Archives of ophthalmology*, *122*(1), 48-53.
28. Sibony, P. A., Wei, J., & Sigal, I. A. (2018). Gaze-evoked deformations in optic nerve head drusen: repetitive shearing as a potential factor in the visual and vascular complications. *Ophthalmology*, *125*(6), 929-937.
29. Mullie, M. A., & Sanders, M. D. (1985). Scleral canal size and optic nerve head drusen. *American journal of ophthalmology*, *99*(3), 356-359.
30. Thurtell, M. J., Biousse, V., Bruce, B. B., & Newman, N. J. (2012). Optic nerve head drusen in black patients. *Journal of Neuro-Ophthalmology*, *32*(1), 13-16.
31. Malmqvist, L., Li, X. Q., Eckmann, C. L., Skovgaard, A. M., Olsen, E. M., Larsen, M., ... & Hamann, S. (2018). Optic disc drusen in children: the Copenhagen child cohort 2000 eye study. *Journal of Neuro-Ophthalmology*, *38*(2), 140-146.
32. Rueløkke, L. L., Malmqvist, L., Wegener, M., & Hamann, S. (2020). Optic disc drusen associated anterior ischemic optic neuropathy: prevalence of comorbidities and vascular risk factors. *Journal of Neuro-Ophthalmology*, *40*(3), 356-361.