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Normal measurements of optic nerve sheath diameter in Indian population

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Abstract
Aims and Objectives: The aim of this study was to establish normal measurements of the optic nerve sheath diameter (ONSD) on magnetic resonance imaging (MRI).
Materials and Method: 100 normal individuals between 3 months and 79 years were included in this study and diameter of ONS was taken at 3 mm behind the globe in T2W sequence using 1.5 tesla Magnetom Essenza Siemens MRI machine and the result was analysed.
Results: A total of 100 participants with mean age of 31.11 years were studied. The overall intraorbital mean ONSD was 4.656 mm (range: 3.6 mm–7.6 mm, (S.D.- 0.732) on Rt side; while on Lt side it was 4.663 mm (range: 3.3 mm–7.6 mm, (S.D.- 0.733). There were no statistical differences in the measurements between gender and also laterality. Our range were consistent with many published data on ONSD.
Conclusion: There are few studies done in Indian population to measure normal ONSD. So, this study can be used as reference in the management of conditions affecting ONSD.

Keywords: normal measurements, MRI, ONSD, diameter

Introduction
Accurate imaging assessment of the OPTIC NERVE SHEATH DIAMETER (ONSD) requires knowledge of the normal anatomy and dimensions of these structures. The ONSD comprises the optic nerve (ON) and optic nerve sheath (ONS). Disease detection affecting the ONSD may be made subjectively. However, objective measurement of these structures is often a very valuable part of the diagnostic assessment.

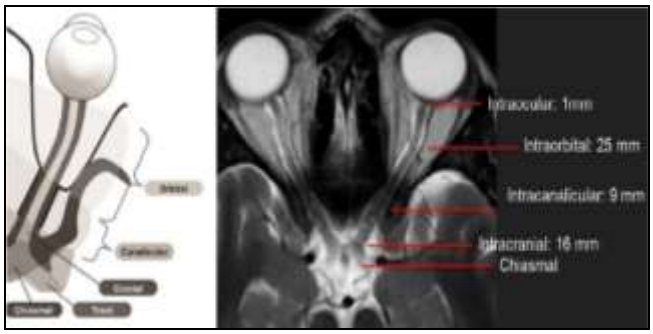

Fig 1: Axial T2WI illustrating the normal optic nerve anatomy and its 4 segments

A spectrum of diseases may affect the size of ONSD [1]+. Multiple intracranial pathology causing raised intracranial pressure (ICP) such as cryptococcal meningitis, trauma and neoplasm. Common clinical requests include evaluation of the ONSD for conditions like atrophy or neuritis and intracranial pathology causing mass effect on The visual pathway structures. The World Health Organization (WHO) estimates that approximately 1.3 billion people live with some form of visual impairment globally, out of which 80% is considered avoidable [4] it is important to know the accurate normal value of ONSD so that we can achieve an early diagnosis, to allow prompt intervention to maintain or restore vision and prevent permanent blindness. Different modalities have been used in the past to image the ONSD with varying degrees of accuracy. Most of those modalities are outdated.
The older studies were based on computed tomography (CT) scan and low-resolution magnetic resonance imaging (MRI) images, which possibly could not measure the ONSD accurately. Here we use the high-resolution MRI. As most of the studies were done over the western world population and very few over Indian population. The aim of this study was to ascertain normal measurements of the ONSD in the normal Indian population.

Aims and Objectives
The aim of this study is to establish normal measurements of the optic nerve sheath diameter (ONSD) on magnetic resonance imaging (MRI). The optic nerve is surrounded by cerebrospinal fluid (CSF), which is contiguous with intracranial CSF. Increased ICP is transmitted through this subarachnoid space causing distention of the dural optic nerve sheath, especially the retrobulbar segment [1]. The optic nerve and its surrounding sheath can be imaged and measured on MRI using a fat-suppressed T2-weighted sequence [2, 3].

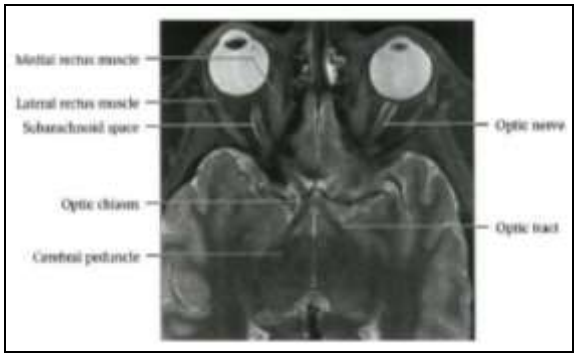

Fig 2

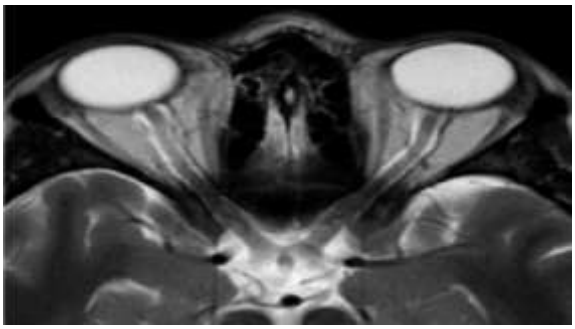

Fig 3

Materials and Method

100 normal individuals between 3 months and 79 years were included in this study and diameter of ONS was taken at 3 mm behind the globe in T2W sequence using 1.5 tesla Magnetom_Essenza Siemens MRI machine and the result was analysed. Measurements of the optic nerve sheath diameter (ONSD) are most often taken at a distance of 3 mm from the posterior globe margin as this is believed to be the site of maximum pressure changes along the long axis of the optic nerve [6, 7, 8]. The ONSD was measured just behind the optic globe. The retrobulbar area was zoomed and then ONSD was measured in an axis perpendicular to the optic nerve, 3 mm behind the globe using an electronic caliper.

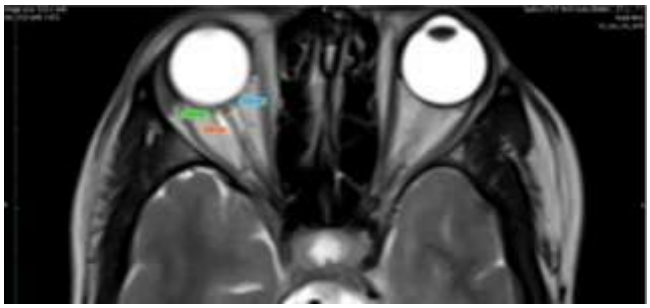

Fig 4: Measurement of optic nerve sheath diameter 3mm behind the globe on T2-weighted magnetic resonance imaging

Exclusion Criteria

Patients with a history of optic neuritis, arachnoid cyst of the optic nerve, high myopia, optic nerve trauma, head trauma and anterior orbital or cavernous sinus mass are excluded from the study.

Results

A total of 100 participants with mean age of 31.11 years were studied: 50 females (50%) and 50 males (50%). The overall intraorbital mean ONSD was 4.656 mm (range: 3.6 mm–7.6 mm, (S.D.- 0.732) on Rt side; while on Lt side it was 4.663 mm (range: 3.3 mm–7.6 mm, (S.D.-0.733).

Table 1: demonstrates a summary of the overall measurement

ONSD measured using magnetic resonance imaging

	Mean±SD	Minimum	Maximum
ONSD (mm)			
Right	4.656±0.732	3.40	7.60
Left	4.663±0.733	3.30	7.60
Overall	4.659±0.732	3.30	7.60

There were no measurements with significant statistical differences between males and females (Table-2, graph 1).

Table 2: demonstrates a summary of the overall males and females measurement

MALES				FEMALES			
	Mean±SD	Minimum	Maximum		Mean±SD	Minimum	Maximum
ONSD (mm)				ONSD (mm)			
Right	4.719±0.734	3.40	7.60	Right	4.593±0.733	3.50	7.00
Left	4.720±0.730	3.30	7.60	Left	4.606±0.738	3.50	7.00
Overall	4.719±0.733	3.35	7.60	Overall	4.599±0.735	3.50	7.00

Graph 1

Discussion

This study reports normal measurements of ONSD in normal Indian population using high-resolution MRI. There were no statistically significant differences between males and females for all the acquired measurements of the anterior visual pathway. This finding is consistent with the previous literature and is expected because there are no known structural or physiological differences of the ONSD between sexes.

Dural covering continues as optic nerve sheath that increases in size, when there is raise in ICP. Edema of the optic disc was earlier considered a sign of raised ICP, but was not shown to be a sensitive marker as it takes many days to develop [9]. It was shown that ONSD increases within seconds of raise in ICP. It was reported earlier that

high-resolution MRI had been accurate at measuring ONSD [10, 11]. The reason of selection of MRI of the optic nerve sheath as a reference is due to its high spatial resolution and the clear delineation of orbital structures. In this study we report normative values of ONSD measured on MRI. There were no statistical differences in the measurements between gender and also not with weight, height, BMI and laterality. Our range were consistent with many published data on ONSD.

Conclusion

Normal measurements of the intra-orbital ONSD on MRI are 4.656±0.7 (range3.3–7.6). Inter-observer variability was poor for the orbital ONSD. Therefore, we recommend that measurements should be obtained by the single observer. There are few studies done in Indian population to measure normal ONSD. So, this study can be used as reference in the management of conditions affecting ONSD.

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