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Original Research Article

Computed Tomographic Assessment of Optic Foramen

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Abstract

A detailed morphometric study of optic foramen was conducted in the CT scans of 30 adult patients. The quantitative and qualitative parameters were observed. The transverse diameter (TD), the vertical diameter (VD) and the distance of optic foramen to apex of petrous temporal bone were measured as quantitative parameters. The qualitative parameters measured were shape, margin and confluence. The frequency of range of transverse and vertical diameters was also observed. A comparison was made between right and left sided morphometric values. The mean transverse diameter of optic foramen was found to be greater on right side, whereas mean vertical diameter was observed to be greater in left sided optic foramen.

Keywords: Anatomy, CT scan, morphometry, optic canal, foramen

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Introduction

A detailed anatomical and morphometric data of optic canal and its relation with surrounding important osseous landmarks provide us valuable insight for diagnosis of any pathology through imaging techniques and its surgical interventions. Optic canal is formed by the anterior and posterior roots of lesser wing of sphenoid and connects the middle cranial fossa to the apex of the orbit. The canal is traversed by the optic nerve, its meningeal coverings, ophthalmic artery and branches of periarterial sympathetic plexuses (1).

In recent years imaging techniques have become very advanced and it has been possible to diagnose even minute alterations in the anatomy due to any trauma or pathological conditions. Knowledge of normal morphometry and anatomy of optic canal is of immense importance for Radiologists, Neurosurgeons and Ophthalmologists for accurate diagnosis and interventions (2).

Materials and Methods

The study was conducted on CT scans of head region of 30 adult patients at Vardhman Mahavir Medical College and Safdarjung Hospital, New Delhi.

High resolution unenhanced computed tomography scans of the skull base were performed on a 40 slice Philips Brilliance 190 P scanner. Spiral volumetric data acquisition was done through skull base to the vertex or as per clinical indications. Thin sections 1 – 1.5 mm were reconstructed in axial plane parallel to the infraorbitomeatal line. Coronal plane images were obtained perpendicular to this plane. High resolution matrix and bone algorithm was used. In the present study qualitative parameters observed were shape, margins and confluence of optic foramen, in the mean time transverse diameter, vertical diameter and distance optic foramen to apex of petrous temporal bone were quantitative parameters that were observed. CT scan pictures optic canal are depicted in Figure 1.

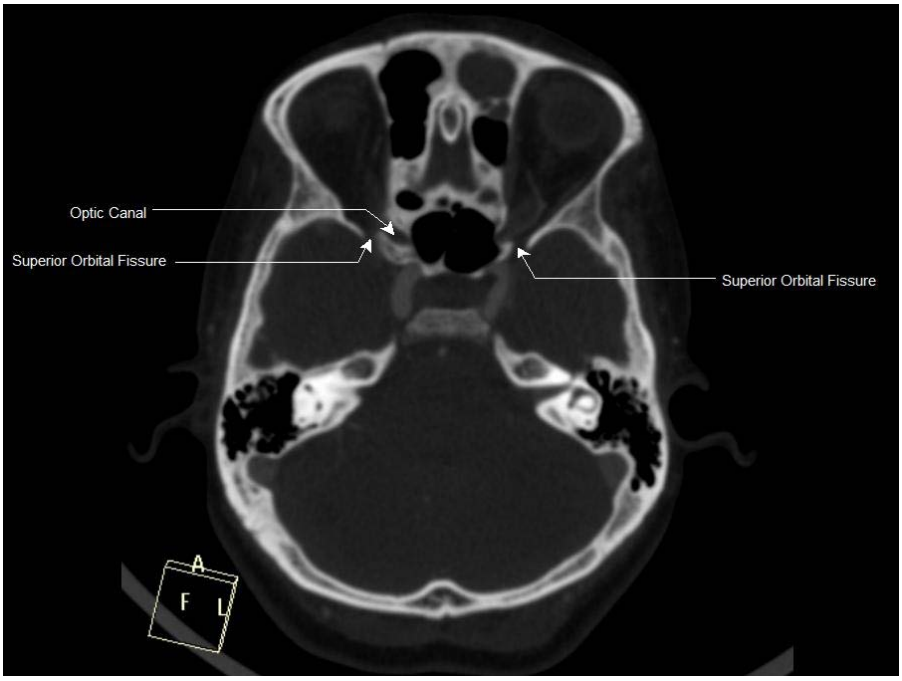

Figure 1: CT scan figure depicting optic foramen

Table 1: Morphometric obsevations of optic foramen in ct scans of patients

Parameters	Mean ±SD (mm) (n) Range = Max – Min (mm)		p Value
	Left (n = 30)	Right (n =30)	
Transverse Diameter	5.73 ± 0.99 (7.00 – 3.40)	5.82 ± 1.04 (7.30 – 3.90)	0.540
Vertical Diameter	3.85±0.81 (7.40 – 3.10)	3.74 ± 0.79 (7.00 – 2.40)	0.123
Distance of Optic Foramen to Apex of Petrous Temporal Bone	26.45 ± 3.02 (32.70 – 20.0)	26.10 ± 2.86 (33.10 – 21.40)	0.313

The statistical analysis was performed by applying paired – t test using SPSS software version 19.00 for observing statistically significant side dimorphism of the traits if present ($p \leq 0.05$ was considered statistically significant). Mean value, standard deviation and range was taken into consideration for the statistical analysis.

Results

The optic foramen was present bilaterally in all the CT scans of patients examined. The shape of foramen was found to be round with regular margins in all the CT scans. There was no evidence of any unusual morphological variations of the optic foramen in any of the CT scan.

The morphometric observations of optic foramen are depicted in Table 1. The mean transverse diameter of optic foramen in CT scan was 5.73 ± 0.99 mm (Range 7.00 – 3.40 mm) on left side and 5.82 ± 1.04 mm (Range 7.30 – 3.90 mm) on right side. The mean vertical diameter was 3.85 ± 0.81 mm (Range 7.40 – 3.10 mm) on left side and 3.74 ± 0.79 mm (Range 7.00 – 2.40 mm) on right side. The mean distance of optic foramen to apex of petrous temporal bone in CT scan 26.45 ± 2.86 mm (Range 32.70 – 20.00 mm) on left side and 26.10 ± 2.86 (Range 33.10 – 21.40) on right side.

The transverse diameter observed in CT scan study ranged from 3.40 mm to 7.30 mm (Table 2) but majority of values were in the range between 6.00 mm

to 6.90 mm on both sides. Similarly, the values observed for vertical diameter in CT scan study were in the range between 2.40 mm to 7.40 mm (Table 3) but majority of the values fall in the range between 3.00 mm to 3.90 mm on both sides.

Discussion

The canal provides passage to optic nerve, which is covered by meninges, ophthalmic artery and sympathetic plexus surrounding the artery. It is bounded medially by the body of sphenoid bone , superiorly by the superior root of lesser wing of sphenoid bone, inferolaterally by the optic strut (inferior root of lesser wing of sphenoid) and laterally by the anterior clinoid process (3).

The embryological basis of the canal development involves formation of cartilaginious optic foramen, which later ossify and canalization of foramen into optic canal. The latter depends on the normal development of optic strut (1). The anomalous growth of the strut might result in varied shapes and asymmetries of optic canal (4).

The narrowing of optic foramen may lead to optic nerve compression, leading to optic nerve death termed as optic neuropathy, resulting in gradual vision loss or gradual worsening of vision. Characteristic features include reduced visual acuity, dyschromalapsia, a relative afferent papillary defect, visual field defect and optic atrophy. The optic neuropathy is difficult to diagnose because onset of vision loss is slow and initial clinical findings are overlapped with glaucoma, cataract, optic neuritis or maculopathy.

In the present study, single round shaped optic foramen was observed bilaterally in CT scans of all the patients. This observation is at slight variance with an earlier study that reported some morphological variants such as key – hole anomaly and figures of eight optic canal (5).

The mean transverse diameter of optic foramen was found to be greater on the right side, whereas mean vertical diameter was found to be greater on left side. Further the mean distance of optic foramen to apex of petrous temporal bone was compared between the two sides. The statistical analysis revealed that the difference was insignificant. The mean dimensions of optic foramen were also compared with earlier studies (Table 4).

Table 2: Correlation between transverse diameter and number of cases

Range (mm)	Number of Cases	
	Left Side	Right Side
3.0 – 3.9	3	1
4.0 – 4.9	4	7
5.0 – 5.9	5	5
6.0 – 6.9	17	12
7.0 – 7.9	1	5

Table 3: Correlation between vertical diameter and number of cases

Range (mm)	Number of cases	
	Left Side	Right Side
2.0 – 2.9	0	3
3.0 -3.9	21	19
4.0 – 4.9	7	7
5.0 – 5.9	1	0
6.0 – 7.9	1	1

Table 4: Mean dimensions of optic foramen in various studies in CT scan

Studies	Tranverse Diameter (td) (mm)	Vertical Diameter (vd) (mm)
Berlis et al (1992)	7.64	3.63
Hart et al (2009)	6.70	4.00
Kalthur et al (2013)	4.59	3.60
Present Study	5.73 (L), 5.82 (R)	3.85 (L), 3.74 (R)

Morphometric dimensions of present CT scan study were compared with the dimensions observed by previous CT scan study. The values of TD in present study (5.73 mm on left side and 5.82 mm on right side) was higher than the values observed by Kalthur et al. (4.59 mm), but lower than the values observed by Berlis et al. (7.64 mm) and Hart et al. (6.70 mm) (6). The values of VD in present CT scan study (3.85 mm on left side and 3.74 mm on right side) was comparable with the values observed by Berlis et al. (3.63 mm) and Kalthur et al. (3.60 mm), but was lower than the values obtained by Hart et al. (4.00 mm) (6). The difference in values may possibly be attributed to regional and racial variations.

As the optic foramen is giving passage to neurovascular structures including intracranial portions of optic nerve with surrounding meninges and ophthalmic artery, detailed knowledge of optic foramen is of immense importance for neurosurgeons during subfrontal and intracanalicular procedures (7). Some tumors of orbit ie angioma, pneumosinus, meningioma, neuroma and tumors of lesser wing of sphenoid bone are approached through intracranial part of optic canal and superior orbital fissure (8).

Conclusion

The present study is an endeavour to provide baseline data on the morphometric details of optic foramen in Indian subjects. It is expected that these values will be relevant to neurosurgeons and ophthalmologists in their clinical practice.

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