Anatomical and Morphometric Study of Optic Foramen in North Indian Population

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Abstract

Introduction Optic canal connects orbit to middle cranial fossa. Optic nerve and ophthalmic artery pass through this canal. The aim of the present study is to make morphometric and anatomical observations of endocranial opening of optic canal.

Materials and Methods The observations were conducted on 30 dry adult human skulls. The observations were made on shape, margins, confluence, septations, dimensions, and distance of optic foramen from apex of petrous temporal bone.

Result and Statistical Analysis On morphometric observation, transverse diameter (TD) was 6.00 mm and 6.15 mm on the left and the right side, respectively. The vertical diameter (VD) was 5.14 mm on the left side and 4.82 mm on the right side. The distance of optic foramen to apex of petrous temporal bone was 21.84 mm on the left side and 21.90 mm on the right side. The mean, standard deviation, range, and p value were measured by using SPSS software version 19.00.

Conclusion In the present study we attempt to provide a comprehensive anatomical and morphometric data of optic foramen that may help ophthalmologists and neurosurgeons during surgery.

Keywords ► optic foramen ► dry skull ► morphometry ► dimensions

Introduction

Optic canal connects orbit to middle cranial fossa. It is present in the lesser wing of sphenoid bone and bounded by two roots of lesser wing and body of sphenoid bone. The structures passing through optic canal are optic nerve, dura and arachnoid matter, ophthalmic artery, and sympathetic nerve.¹⁻⁵ As optic nerve passes from the optic canal, injury in this region can lead to visual defect, so it becomes imperative for ophthalmologists to have comprehensive knowledge of optic foramen morphometry and its related structures.⁶ In the present study we tried to obtain comprehensive anatomical and morphometric data of optic foramen. The present study is also an attempt to find out the frequency of anomaly in optic canal. Duplication of optic canal is a rare anomaly, which may present unilaterally²,⁷ or bilaterally.⁵,¹⁰

Materials and Methods

The study was carried out in the Department of Anatomy, Subharti Medical College, Meerut. The present study was carried out on 30 dry adult human skulls.

Inclusion criteria:
• Bones with normal gross morphology.
• Adult human skulls.

Exclusion criteria:
• Skulls showing gross deformity or defects

The observations on the foramina were recorded using following parameters:
1. Dimensions (transverse diameter and vertical diameter).
2. Shape.
3. Margins (presence of tubercles, spine, notch, etc.).

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4. Septation (presence of osseous spur/bridges dividing the foramina).
5. Distance from optic foramina to apex of petrous temporal bone.

All these measurements were noted endocranially. These measurements in the dry human skulls were recorded by using digital Vernier caliper with sensitivity 0.1 mm. The observations were carefully recorded and discussed in the light of previous literature.

**Statistical Evaluation**

The data obtained from the present study were analyzed as per standardized methods. The analysis was performed by applying paired t test using SPSS software (IBM SPSS V19.0; IBM Inc. Ltd. United States), for comparison of morphometric parameters of right and left sides and \( p \leq 0.05 \) was considered statistically significant. Mean values, standard deviation and the range were taken into consideration in the statistical analysis.

**Results**

Optic foramen was present bilaterally in all the dry skulls examined. The shape of the foramen was round with regular margins in all the specimens. No skull displayed septation of optic foramen or any other unusual morphological features.

The morphometric observations of optic foramen are depicted in **Table 1**. The mean TD of optic foramen in dry skulls was 6.00 ± 0.86 mm (range 4.00–8.00 mm) on left side and 6.15 ± 0.81 mm (range 7.60–4.00 mm) on right side. The mean vertical diameter (VD) was 5.14 ± 0.73 mm (range 4.00–7.00 mm) on left side and 4.82 ± 0.77 mm (range 3.50–7.20 mm) on right side. The mean distance of optic foramen to apex of petrous temporal bone was 21.84 ± 1.41 mm (range 19.20–25.40 mm) on left side and 21.90 ± 1.15 mm (range 19.80–24.20 mm) on right side.

The TD observed in dry skulls were ranged from 4.00 mm to 8.00 mm (**Table 1**) but majority of the values were in the range between 6.00 mm and 6.9 mm on both sides (**Table 2**). Similarly, the values of vertical diameter were in the range between 3.5 mm and 7.2 mm (**Table 1**) but majority of the values fall in the range between 4.5 mm and 5.4 mm on both the sides (**Table 3**).

**Discussion**

Optic canal is present in the lesser wing of sphenoid bone and formation of lesser wing occurs by the ossification of ala orbitalis cartilage at 12th to 16th week of gestation. So the formation of optic canal is completed at the 16th week of gestation.\(^1\)

Optic nerve and ophthalmic artery are susceptible to various diseases and injuries; therefore, knowledge of optic canal morphometry is important for the proper diagnosis and intracanalicular procedure.\(^2\)

Some tumors like meningioma grown through the bone to compress the structures present within the canal. In order to relieve compression bony border of canal is removed. Sometimes these tumors (meningioma and Schwannoma) grow along with optic nerve, requiring various parts of optic canal to be opened. So removal of bones of optic canal is a frequent procedure in these conditions.\(^3\) This makes the present study very important for the reference of comprehensive data of optic foramen and related structures.

The present study makes an attempt eliminate the lacunae present on existing knowledge. The most important lacunae

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**Table 1** Morphometric observations of optic foramen in dry skulls

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Mean ± SD (mm)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Left (( n = 30 ))</td>
<td>Right (( n = 30 ))</td>
</tr>
<tr>
<td>Transverse diameter</td>
<td>6.00 ± 0.86 (8.00–4.00)</td>
<td>6.15 ± 0.81 (7.60–4.00)</td>
</tr>
<tr>
<td>Vertical diameter</td>
<td>5.14 ± 0.73 (7.00–4.00)</td>
<td>4.82 ± 0.77 (7.20–3.50)</td>
</tr>
<tr>
<td>Distance of optic foramen to apex of petrous temporal bone</td>
<td>21.84 ± 1.41 (25.40–19.20)</td>
<td>21.90 ± 1.15 (24.20–19.80)</td>
</tr>
</tbody>
</table>

* Significant.

**Table 2** Correlation between transverse diameter and number of cases

<table>
<thead>
<tr>
<th>Range (mm)</th>
<th>Number of cases</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Left side</td>
</tr>
<tr>
<td>4.0–4.9</td>
<td>1</td>
</tr>
<tr>
<td>5.0–5.9</td>
<td>11</td>
</tr>
<tr>
<td>6.0–6.9</td>
<td>12</td>
</tr>
<tr>
<td>7.0–8.0</td>
<td>6</td>
</tr>
</tbody>
</table>

**Table 3** Correlation between vertical diameter and number of cases

<table>
<thead>
<tr>
<th>Range (mm)</th>
<th>Number of cases</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Left side</td>
</tr>
<tr>
<td>3.5–4.4</td>
<td>4</td>
</tr>
<tr>
<td>4.5–5.4</td>
<td>18</td>
</tr>
<tr>
<td>5.5–6.4</td>
<td>5</td>
</tr>
<tr>
<td>6.5–7.5</td>
<td>3</td>
</tr>
</tbody>
</table>
present in existing knowledge is the lack of comprehensive data of optic foramen in north Indian population. Another important lacuna that has never been addressed by previous studies is the usage of osseous landmarks as reference points for describing topography of optic foramina.

In the present study value of TD is larger on right side but difference was not significant. Similarly, value of VD on left side is larger than right side but difference was statistically significant as $p$ value was $\leq 0.05$ (►Fig. 1). The value of the distance of optic foramen to apex of petrous temporal bone was slightly higher on right side but difference was not significant.

Morphometric dimensions in the present study in dry skulls were compared with the dimensions observed in previous studies. The mean values of TD in present study (6.00 mm on left side and 6.15 mm on right side) was higher than the values observed by Govsa et al. and Kalthur et al. but it is comparable to the observations made by other researchers (►Table 4). The mean value of VD in the present study (5.14 mm on left side and 4.82 mm on right side) is higher than the value of most of previous researchers except one researcher, where values are comparable.

### Conclusion

The present study was an attempt to provide comprehensive data of anatomic and morphometric details of optic foramen and we expect it will help neurosurgeons while operating meningioma. In the present study we found that there is a significant difference in the value of VD between two sides and left being larger than right side. Our study may also help ophthalmologists during posterior compartment surgeries.

►Figs. 2 to 4 show how the measurements were taken and can be used as evidence.
Funding
None.

Conflict of Interest
None.

References

Fig. 3 Depicting transverse diameter.

Fig. 4 Depicting distance from optic foramen to apex of petrous temporal bone.