

# Anthropometric Evaluation of Foramen Ovale in Adult Dry Skulls of the Mysuru-based Population

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## Abstract

**Introduction** The greater wing of sphenoid presents various foramina, of which the foramen ovale is one important foramen through which advanced surgical therapeutic and diagnostic procedures related to the middle cranial fossa are performed.

**Materials and Methods** A total of 40 dried adult skulls of unknown gender and age, obtained from the Department of Anatomy of the JSS medical College, Mysuru, Kamakata, India. The length and the width of the foramen ovale were measured using digital sliding calipers (tiny deal 150 mm SS digital caliper with LCD display, Kristeel-Shimwa industries, Bombay, India).

**Results** The mean length of the foramen ovale was  $0.745 \pm 0.31$  cm on the right side (RS), and  $0.68 \pm 0.15$  cm on the left side (LS). The mean width was  $0.6 \pm 0.17$  cm on the RS, and  $0.56 \pm 0.14$  cm on the LS.

**Conclusion** The knowledge of variations in the length and breadth of the foramen ovale is of immense importance in neurosurgery during various invasive surgical procedures, such as percutaneous trigeminal rhizotomy, and in the biopsy of cavernous sinus tumors and of Meckel cave lesions.

## Keywords

- ▶ foramen ovale
- ▶ greater wing of sphenoid
- ▶ middle cranial fossa
- ▶ mandibular nerve

## Introduction

The foramen ovale is one of the important foramina in the greater wing of the sphenoid bone, through which the infra-temporal fossa communicates with the middle cranial fossa. It is located lateral to the foramen lacerum and medial to the foramen spinosum. It transmits the mandibular division of the trigeminal nerve, of the lesser petrosal nerve, of the accessory meningeal artery, and of the emissary vein connecting the pterygoid venous plexus with the cavernous sinus.<sup>1</sup>

The foramen ovale is used for various invasive surgical and diagnostic procedures.<sup>2</sup> The foramen ovale is one of the important routes for the spreading of nasopharyngeal carcinomas into the cranial cavity.<sup>3</sup>

Like other foramina of the skull, the foramen ovale also differs in shape, size and other morphological features. Sometimes, it is covered by an osseous ligament extending from the lateral pterygoid plate to the spine of the sphenoid bone.<sup>4</sup> Ossified pterygospinous and pterygoalar ligaments divide the foramen ovale into compartments.<sup>5</sup> They can compress

the structures passing through it or block the passage of the needle through the foramen ovale.<sup>6,7</sup> A bony spur on the anteromedial side divides the foramen ovale in two.<sup>8</sup>

The right side (RS) foramen ovale is smaller than the left side (LS) foramen ovale.<sup>9</sup> The available literature reveals that the foramen ovale shows a wide range of variations. The present study aims to measure the length and the width of the foramen ovale, the knowledge of which helps in reducing complications during surgeries for neurological diseases.

## Materials and Methods

The present study was conducted on 40 dried adult skulls of unknown gender and age obtained from the Department of Anatomy of the JSS Medical College, Mysuru, Kamakata, India. Ethical clearance was obtained from the institutional ethical committee to conduct this study. The measurement of the length (Anteroposterior diameter) and width (transverse diameter) of the foramen ovale was taken using sliding

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**Table 1** The following observations were made

Parameters	Mean and SD
Right side length	0.745 ± 0.31 cm
Left side length	0.68 ± 0.15 cm
P-value	0.26
Right side width	0.6 ± 0.71 cm
Left side width	0.56 ± 0.14 cm
P-value	0.29

Abbreviations: SD, standard deviation.

digital calipers (Kristeel-Shimwa industries, Bombay, India) and then analyzed (►Fig. 1 and ►Fig. 2).

**Observations**

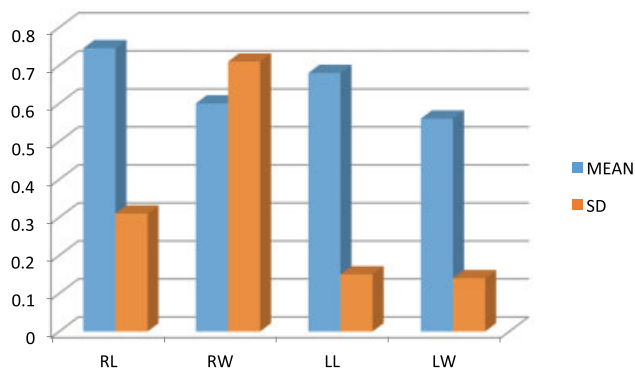
The present study was conducted on a total of 80 sides of 40 dry adult skulls. The mean length of the foramen ovale was 0.745 ± 0.31 cm on the RS, and 0.68 ± 0.15 cm on the LS. The mean width was 0.6 ± 0.17cm on the RS, and 0.56 ± 0.14 cm on the LS (►Table 1).

The length and the width were longer on the RS when compared with the LS. The difference between the length of the RS and of the LS was not statistically significant ( $p > 0.05$ ). Similarly, the difference between the width of the RS and of the LS was not statistically significant (Graph 1).

**Discussion**

In the present study, the mean length of the foramen ovale was 0.745 ± 0.31 cm on the RS, and 0.68 ± 0.15 cm on the LS. The mean width was 0.6 ± 0.17 cm on the RS, and 0.56 ± 0.14 cm on the LS. Therefore, both the length and the width are longer on the RS when compared with previous studies.

In his developmental study, Yanagi<sup>10</sup> reported that the length of the foramen ovale in newborns is ~ 3.85 mm, and ~ 7.2 mm in adults. The earliest appearance of the foramen ovale as a ring-shaped area is seen in the 7<sup>th</sup> month of intrauterine life and lasts for 3 years after birth.<sup>8</sup>



**Graph 1** Bar chart showing mean ± standard deviation of the length and of the width of the foramen ovale. Abbreviations: LL, left length; LW, left width; RL, right length; RW, right width; SD, standard deviation.



**Fig. 1** Base of the skull showing the foramen ovale.



**Fig. 2** Showing the measurement of the foramen ovale using digital sliding calipers.

Lang et al<sup>11</sup> reported that the average maximum length of the foramen ovale is ~ 7.48 mm, and that the average minimum length is ~ 4.17 mm in adults. The width ranges from 1.81 mm in newborns to 3.7 mm in adults.<sup>12</sup>

A study by Chandra Philips et al<sup>13</sup> conducted on 50 dry skulls showed that the mean length of the foramen ovale was 7.27 ± 1.41 mm on the RS, and 7.46 ± 1.41 mm on the LS.<sup>14</sup>

A study by Patel et al<sup>12</sup> conducted on 100 dry skulls showed that the mean length of the foramen ovale was 6.6 mm on the RS, and 6.5mm on the LS. The RS foramen ovale was longer than the LS. The mean width was 3.6 mm on the RS, and 3.5 mm on the LS.<sup>7</sup>

Ray et al<sup>2</sup> conducted a study on 35 dry skulls that showed that the mean length of the foramen ovale was 7.46 ± 1.41 mm on the RS, and 7.01 ± 1.41 mm on the LS. The mean width was 3.21 ± 1.02 mm on the RS, and 3.29 ± 0.85 mm on the LS.

In the present study, the length and the width are longer on the RS when compared with the LS, which is in line with the studies conducted by Daimi et al<sup>6</sup> and by Patel et al.<sup>12</sup>

It is through the foramen ovale that many invasive surgeries and diagnostic procedures are performed.<sup>2</sup> Percutaneous trigeminal rhizotomy in trigeminal neuralgia is also performed through the foramen ovale.<sup>15</sup> Percutaneous biopsy of cavernous sinus tumors and biopsy of deep lesions of the brain, such as Meckel cave lesions, are performed through the foramen ovale, which decreases patient morbidity and is cost-efficient.<sup>14,16</sup> The foramen ovale is also used to diagnose squamous cell carcinomas and meningiomas via computed tomography (CT) guided transfacial fine needle aspiration.<sup>17</sup>

It is through the foramen ovale that the trigeminal nerve is accessed. Therefore, the variations in the length and in the width of the foramen ovale are of utmost importance during the anesthesia of the trigeminal nerve.

## Conclusions

The present study demonstrates the anthropometric significance of the foramen ovale, which may help radiologists and neurosurgeons. These variations in measurements of foramen ovale found in the present study may be useful for treating trigeminal neuralgia, abnormal tumors, and to perform biopsies from deeper parts of the brain.

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