

## Original Article

### Anatomical Variations of Spleen in South Indian Population.

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#### Abstract

**Background:** Spleen is the large lymphoid organ that is situated in the left hypochondriac region and is usually wedge shaped. It has two ends, two surfaces and three margins. Superior margin of the spleen possesses characteristic notches. Normally spleen is not palpable. It develops in dorsal mesogastrium during the 5th week of fetal life from a mass of mesenchymal cells.

**Objectives:** The present study explains the morphology of spleen 1.To determine the length of spleen 2.To determine the breadth of spleen 3.To determine the thickness of spleen 4.To determine the variations in notches & shape of spleen 5.To compare the morphometric measurements with previous studies

**Results:** In our study, the length, breadth and thickness of spleen was 9.19 cm, 6.61 cm and 3.25 cm respectively. The length of spleen ranged between 5-8cm in 35% of spleens, 8.1-10cm in 35%, 10.1-12cm in 24% and >12.1cm in 6% of spleens studied. Majority of the length of spleens ranged between 5-8cm and 8.1-10cm. The breadth ranged between 3.5-5.5cm in 25% of spleens, 5.6-7.5cm in 45%, 7.6-9.5cm in 20% and 9.6-11.5cm in 10% of spleens studied. The maximum range of breadth of spleen was 5.6-7.5cm in our study. The thickness of spleen ranged between 1-4cm in 82% of spleens, 4.1-6cm in 10% of spleens and 6.1-8cm in 8% of spleen maximum being 1-4cm. 5 fissures and 6 lobules in one of the spleens were observed. These fissures were from the superior border. A deep fissure on the diaphragmatic surface was also observed. The shape of spleen was wedge shaped in 34 % of the spleens being the maximum and next was oval shaped spleens and heart shaped spleens and crescent shaped spleens were the least found in 1% only. The weight of the spleen ranged between 40-500gms, heaviest being 461.1 gms in one of the spleen and least being 47.8gms.

**Conclusion:** The detailed knowledge on variations of spleen is important in clinical practice to avoid and prevent any complications and to obtain a good operative, as well as diagnostic intervention.

**Keywords:** Splenic notches, Polysplenia, Wandering spleen.

#### Introduction

Spleen is the large lymphoid organ in the body. It is located in the left hypochondrial region. It is wedge shaped and has two ends i.e. anterior and

posterior, two surfaces i.e. diaphragmatic and visceral, and three margins i.e. superior, inferior and intermediate. The superior margin of the spleen possesses characteristic notches. The normal adult human spleen is about 1 inch thick, 3 inches broad, 5 inches long and 7 ounces in weight. Normally spleen is not palpable.<sup>1-4</sup> Congenital anomalies of the spleen are believed to be rare and include absence of the spleen, splenic lobulation, duplication, displacement (splenoptosis or wandering spleen), polysplenia and presence of one or more accessory spleens. The most common of the splenic anomalies is the occurrence of accessory spleens, with incidence rate ranging between 10% and 30% in autopsy series, whereas a wandering spleen and polysplenia are less common.<sup>1</sup> Until recently, the spleen was considered to be a less significant organ but now it is known to be important in circulatory and immune systems.<sup>5</sup> Studies related

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to morphometric analysis of spleen seem to be underreported and need to be carried out actively at various medical institutions/colleges for obtaining a more concrete information.<sup>6</sup> Despite its clinical significance, spleen is very often prone to certain negligence. Spleen is vulnerable to several surgical complications indicative of splenectomy. As such, the current trend of surgeons is to efficiently conserve much splenic tissue and preserve its significance. Hence, developing an awareness of variations of spleen is of paramount importance from the fundamental view point.<sup>7-10</sup> Hence this study will be useful for clinicians, surgeon, physician, anatomist, radiologist for proper clinical diagnosis and treatment of disease.

### Development of Spleen

Spleen develops from coelomic epithelium of the left leaf of the dorsal mesogastrium in the sixth week of intra-uterine life.<sup>3,4</sup> During the early phase of development, the spleen is signified by a few splenic nodules which ultimately fuse to form the spleen. Some of these nodules may develop independently. This leads to formation of accessory spleens. The foetal spleen is lobulated but the lobulation disappears by birth. However, it may persist along the medial part of the spleen<sup>8</sup> The notches on the superior border of the adult spleen are nothing but the remnants of the grooves that originally separated the fetal lobules.

### Aims & Objectives

The current study will describe the morphology of spleen under the following parameters:-

1. To determine the length of spleen.
2. To determine the breadth of spleen.
3. To determine the width of spleen.
4. To determine the variations in hilum, notches & shape of spleen.
5. To compare the morphometric measurements with previous studies.

### Materials & Methods

The study was conducted on 100 spleens in Department of Anatomy, Sri Devaraj Urs Medical college, Tamaka, Kolar. Dissection was done according to Cunningham's manual. Fatty tissue should be removed by dissection after which the spleen was washed in tap water. All the spleens were studied for the following parameters. Their shapes and percentage of different shapes were then calculated. Weight of the spleen was measured by digital weighing scale. Length of the spleen were recorded as the greatest distance between the two poles of the

spleen. Greatest distance between two points at the same level on the superior and inferior borders was taken as its breadth and the maximum thickness of all the spleens was noted between the diaphragmatic and visceral surfaces. Notches on the superior and inferior borders and the presence of multiple notches were observed. The mean, standard deviation and range of parameters studied will be tabulated and analyzed statistically.

### Results

**Table1: Variations In Length Of Spleen Length (Cm)**

Spleen Length (Cm)	No. of Specimen	Percentage
5-8	35	35
8.1-10	35	35
10.1-12	24	24
>12.1	6	6

The length of spleen ranged between 5-8cm in 35% of spleens, 8.1-10cm in 35%, 10.1-12cm in 24% and >12.1cm in 6% of spleens studied. Majority of the length of spleens ranged between 5-8cm and 8.1-10cm.

**Table 2: Variations in Breadth of Spleen**

Breadth [Cm]	No. Of Specimen	Percentage
3.5-5.5	25	25
5.6-7.5	45	45
7.6-9.5	20	20
9.6-11.5	10	10

The breadth ranged between 3.5-5.5cm in 25% of spleens, 5.6-7.5cm in 45%, 7.6-9.5cm in 20% and 9.6-11.5cm in 10% of spleens studied. The maximum range of breadth of spleen was 5.6-7.5cm in our study.

**Table 3: Variations in Thickness of Spleen**

Thickness [Cm]	No. Of Specimen	Percentage
1-4	82	82
4.1-6	10	10
6.1-8	8	8

The thickness of spleen ranged between 1-4cm in 82% of spleens, 4.1-6cm in 10% of spleens and 6.1-8cm in 8% of spleen maximum being 1-4cm.

**Table 4: Variation in Shapes of Spleen**

Shape of Spleen	Percentage
Wedge	34
Triangular	17
Tetrahedral	17
Oval	21
Irregular	9
Heart/Leaf	1
Crescent	1

In our study, the shape of spleen was wedge shaped in 34 % of the spleens being the maximum and next was oval shaped spleens and heart shaped spleens and crescent shaped spleens were the least found in 1% only.

**Table: 5 Variations in Weight of Spleen**

Range of Weights in Gms	No. of Specimen	Percentage
40-100	40	40
101-200	40	40
201-300	18	18
301-400	18	18
401-500	1	1

The weight of the spleen ranged between 40-500gms, heaviest being 461.1 gms in one of the spleen and least being 47.8gms.

## Discussion

**Table 6: Comparison of Length, Breadth and Thickness of Spleen with Previous Studies.**

Measurement	Gray's Anatomy	Michels NA et al	Rao et al	Chavare et al	Chaudhari et al. <sup>2</sup>	Present study
Average Length	12cm	11cm	10.5cm	9.66cm	9.59cm	<b>9.19cm</b>
Average Breadth	7cm	7cm	8.3cm	6.22cm	6.59cm	<b>6.61cm</b>
Average Thickness	3 to 4 cm	3cm	4cm	3.06cm	4.54cm	<b>3.25cm</b>

The length, breadth and thickness of spleen in the present study was consistent with the study

done by Chavare et al being 9.19 cm, 6.61 cm and 3.25 cm respectively.

**Table 7: Comparison of Shapes of Spleen with Previous Studies**

Shape	Rao et al	Hollinshead Wh	Chaware et al	Chaudhari et al.	Present Study
Wedge	40%	44%	61.26%	33.87%	34%
Triangular	32%	42%	12.61%	19.35%	17%
Tetrahedral	20%	14%	21.62%	32.25%	17%
Oval	8%	-	3.60%	8.06%	21%
Irregular	-	-	0.90%	6.45%	9%
Heart/Leaf	-	-	-	-	1%
Crescent	-	-	-	-	1%



**Figure 1: Wedge shape spleen**



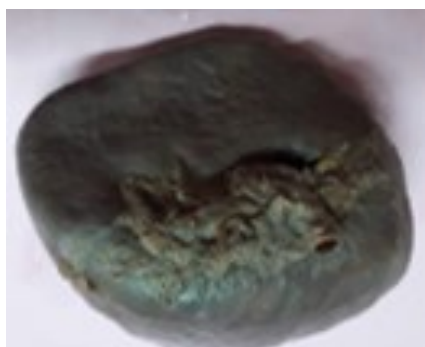
**Figure 5: Crescent shaped spleen**



**Figure 2: Triangular type of spleen**



**Figure 6: Heart or Leaf shaped spleen**



**Figure 3: Oval shape spleen**



**Figure 7: Irregular spleen**



**Figure 4: Tetrahedral shaped spleen**



**Figure 8: Largest and smallest spleen**

**Figure1-8 shows shapes of spleen with largest and smallest spleen.**

Adalet Elcin Yildiz et al stated that the adults with small spleen usually have homozygous sickle cell disease which causes chronic splenic infarction.

In the present study, the spleen which weighed 47.8 gms was the smallest and there was a spleen with narrowest length of 4.7 cms and

narrowest breadth of about 1.7 cms.

The study done by Rao et al and Holinshed et al showed maximum type of shape of spleens to be wedge shaped and tetrahedral in order. Chavare et al and Chaudhari et al showed it to be wedge shape followed by tetrahedral in their study.

In the present study, the maximum shapes of spleen was of wedge type followed by oval type which was unique compared to the other studies.

**Table 8: Comparison of Presence of Notches in Spleen with Previous Studies (Figure 9).**

	Das S et al	Sivangeshwa Rao et al <sup>6</sup>	Shiva chidam-baram et al	Sudhakar et al <sup>9</sup>	Present study
<b>Superior border</b>	98%	70%	63.3%	70%	82%
<b>Inferior border</b>	2%	14%	10%	8%	1%
<b>Diaphragmatic surface</b>	-	-	-	1%	1%
<b>Medial or posterior end</b>	-	-	-	-	2%

**Figure 9: showing notches in spleens.**



Ronald A. Bergman et al.<sup>14</sup> Notches on the anterior, posterior, and inferior borders, and fissures on the diaphragmatic surface of the spleen have been reported. Notches on the posterior border occurred in 32% of cases and on the inferior border in 8%.

Sangeeta et al<sup>12</sup> Notches were only seen on the superior border of the spleen and 44 spleens had single notches. 3 spleens showed the presence of multiple notches of 2 or more.

Sateesha Nayak et al.<sup>13</sup> 25 spleens (50%) did not have any notches on the superior margins.

Occurrence of an abnormal deep fissure on the diaphragmatic surface of the spleen has been

reported recently.<sup>5</sup>

It is quite rare to have deep fissures extending to the diaphragmatic surface and happens only in 1% of cases.<sup>5</sup>

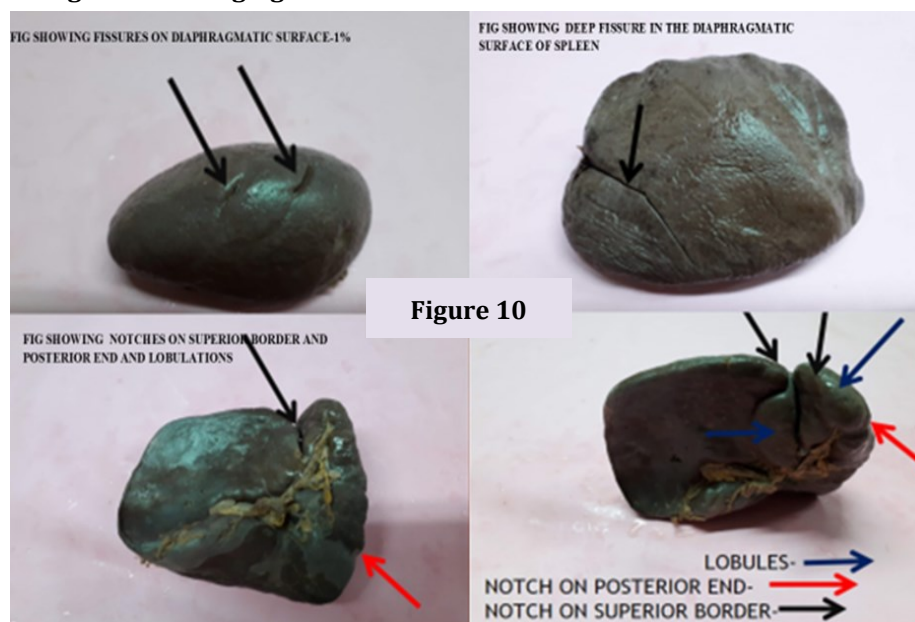
In the present study, there was a deep fissure on the diaphragmatic surface.

Sateesha Nayak et al observed a lobulated spleen 4 hila and 5 deep fissures. Because of these fissures, the spleen appeared to be lobulated, having seven distinct lobes/lobules.<sup>5</sup>

In our study, we observed 5 fissures and 6 lobules in one of the spleens. These fissures were from the superior border. (Figure 10)



**Figure 10: Showing fissures ranging from 1-5.**



**Figure 10**

## Conclusions

Knowledge of the anatomy and function of the spleen is essential for the assessment of its role in disease.

The contribution of spleen to the immune response and defence against infections mandates the preservation of spleen by a conservative approach in the management of ruptured spleen.

Studies on the morphometry of spleen will be of interest not only from academic point of view but also for operating surgeons and interventional radiologists.

The detailed knowledge on variations of spleen is important in clinical practice to avoid and prevent any complications and to obtain a good operative, as well as diagnostic intervention.

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