



## **Morphometric Study of Cadaveric Spleen in Vidarbha Region**

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### **Authors' contributions**

*This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.*

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### **ABSTRACT**

**Background:** Spleen is one of the largest lymphoid organs that are involved in haemopoietic function also during fetal life. Its anatomy is useful not only for Anatomist but also for Surgeons, Radiologists and Physicians. A lot of variations are observed in the spleen from its shape to size which is important to diagnose or treat the number of diseases.

**Methodology:** This study was carried out on 60 spleens in the dissection hall of our medical college which were removed during routine undergraduate dissection. The parameters studied were shape of the spleen, number of notches (single or multiple), location of notches (Superior or inferior border), weight, breadth, width or length.

**Results:** The 90% spleens has single notch. The weight of the spleens ranges from 89 gm to 220 gm with an average 142.6 gm. Range of breadth observed 3.5cm to 7.4cm with an average 5.8cm, Range of width observed 2.8cm to 5.7cm with an average 4.1cm. Range of length observed 8.1cm to 13.2cm with an average 11.7cm.

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**Conclusion:** Morphological variation is very common in spleen and varies according to the genetic, geographic, nutrition and work habits of individual and varies regions to regions of India. Morphological analysis is under reported and need to be carry out at different regions and places for obtaining more accurate data.

*Keywords:*Lymphoid; haemopoitic; morphological; analysis; notches.

## 1. INTRODUCTION

Spleen is a lymphoid organ. It acts as filter of blood. It plays role in immune responses of the body. Spleen is haemopoetic during foetal life. Red blood cells can be stored and released into circulation when needed. The haemopoetic function of the spleen is continuous during foetal life and regresses after birth. The Splenic vessels and sinusoids allow the elimination of the worn out platelets, erythrocytes & leucocytes from the blood by phagocytic activities of reticuloendothelial cells in splenic sinusoids [1].

The knowledge of morphology of human spleen is important to the physicians, surgeons, radiologists and anatomy teaching persons. It is an abdominal organ situated in the left hypochondrium region and partly in the epigastrium. The size and weight of the spleen vary with age [1]. In adults, it is usually 12 cm long, 7 cm broad and 3 to 4 cm wide. Its average adult weight is 150 gm, but the normal range is wide, between 80 and 300 gm [1,2]. The spleen has two surfaces; superolateral or diaphragmatic and visceral; it has two poles, the anterior and the posterior; it has two borders, superior and inferior [1,2,3]. The diaphragmatic surface is convex and smooth. The visceral surface is irregular and it is marked by gastric, renal, colic and pancreatic impressions. The posterior pole usually directed & faces the vertebral column. The anterior pole is broad and it is directed laterally. On the superior border, near the anterior pole, there may be one or two notches [1].

When spleen is enlarged, it extends towards the umbilicus and can be palpated in clinical examination. In 4<sup>th</sup> grade splenomegaly it can extend beyond the umbilicus and can be palpated in right iliac fossa. Spleen can be enlarged in viral infection such as mononucleosis, parasitic infections such malaria, in cirrhosis and other diseases also [3].

### 1.1 Development of Spleen

The human spleen is developed from mesoderm. Spleen develops from the mesoderm in the

cephalic part of the dorsal mesogastrium during 6<sup>th</sup> week of intrauterine life [4]. It developed in the dorsal mesogastrium. The mesenchymal cells collect in the dorsal mesogastrium to form spleen. At first number of lobules appear in the dorsal mesogastrium [4]. The lobules subsequently join to form a single mass, projects undercover of left layer of dorsal mesogastrium. The notches seen along its borders mostly the upper indicate the lobular embryogenesis of spleen. Sometimes multiple lobules may persist in adult spleen. The Splenic tissue differentiates into a number of branching trabecular cords with free cells between the trabeculae. The isolated free cells subsequently differentiate into lymphoblast, erythroblasts, and myeloblasts. Defects in the embryogenesis of spleen disturb the development of spleen & responsible for various congenital anomalies [1,4].

### 1.2 Aims and Objectives

The aim of this study is to find out the morphological variations regarding shape, size, weight, surfaces, borders, notches in human cadaveric spleen in the Vidarbha region and compare the data with the same studies in other regions by different authors. The morphological variations of spleen have limitations in the standard text books and more detailed about the morphometric variation of spleen is needed as to help in the various surgeries, imaging studies, clinical assessment to approach correct diagnosis for surgeons, radiologists, clinicians & Anatomy teaching persons.

## 2. MATERIALS AND METHODS

The present study was conducted in the Dept. of Anatomy, JNMC, Sawangi (M), Wardha from March 2020 to September 2021 over a period of 18 months. This was observational cross-sectional study. The study was initiated after getting approval from Institutional Ethics Committee. Total 60 dissected human adult formalin fixed cadaveric spleens were removed during routine dissection in the departmental

dissection hall by the first year students assisted by table teachers. The spleens were collected without considering the sexual dimorphism. Spleens were removed following Cunningham's Manual of Practical Anatomy [5].

The shapes of all spleens were observed & noted. All the spleens weighed on an electronic weighing machine and their lengths, breadths and widths measured & noted. All the linear measurements were done with the help of spreading and sliding callipers. The borders, surfaces and poles of the spleen were determined. The notches on the borders and the impressions on the surfaces of the spleen were observed carefully. The structures and their relations in the hilum of spleen were also observed. The broken and injured spleens were excluded from the study.

### 3. RESULTS

In this study conducted for Morphometric variations on adult human spleen, total 60 spleens were studied. About 68.33% spleens observed with single notch only at superior border, 10% spleens with single notch at inferior border and 11.67% spleens with single notch at both borders.

06 spleens were observed with multiple notches at borders.

The weight of the spleen ranges from 89 gm to 220 gm with an average 142.6 gm. Range of breadth observed 3.5cm to 7.4cm with an average 5.8cm, Range of width observed 2.8cm to 5.7cm with an average 4.1cm. Range of length observed 8.1cm to 13.2cm with an average 11.7cm.

**Table 1. Showing notches on borders**

	<b>Notches</b>	<b>Spleens (n=60)</b>	<b>% of notches (%)</b>
<b>Single notch</b>	Only Superior border	41	68.33%
	Only Inferior border	06	10%
	Both the border	07	11.67%
<b>Multiple notches</b>		06	10%



**Fig. 1. Absence of Notches over the spleen**



**Fig. 2.**Showing multiple notches along inferior border of spleen

**Table 2.** showing different parameters of spleens

Parameter	Range	Average
Weight	89gm.to 220gm	142.6gm
Breadth	3.5cm to7.4cm	5.8cm
Length	8.1cm to13.2cm	11.7cm.

**Table 3.**Showing the shapes of the spleen observed

Shape of spleens	No of spleens (n=60)	Percentage (%)
Triangular	04	6.7%
Tetrahedral	08	13.3%
Wedge	47	78.3%
Irregular	01	1.7%

The shapes of the spleen were observed as triangular, tetrahedral, wedge shaped and irregular. The commonest shape observed was wedge shape in 47 spleen (78.3%), followed by tetrahedral (13.3%), triangular (6.7%) and irregular in 1.7%.

#### 4. DISCUSSION

As spleen is the largest lymphoid organ and its main function is synthesis of lymphocytes and filtration of unwanted elements from the blood [1]. In foetal life [4], it also produces erythrocytes. In spleen immune responses start against antigen present in circulating blood. Spleen is important in protection from blood born sepsis.

Most of the time the accessory lymphoid tissue is seen near spleen , in the Gastrosplenic ligament, lienorenal ligament, in the greater omentum, along the splenic vessels and along the pancreas also known as accessory spleen [1].

It is seen from the study and on the basis of observations that the Indian population in Vidarbha region of Maharashtra is very crucial to perform surgeries on spleen. Presence of notches, hilar structures, size and shape with multiple variations becomes the part of morphology of spleen. These variations play an important role to the clinicians, surgeons and radiologists and anatomy teachers. Accessory spleens are present 10% to 15% of individuals

[6]. 1% to 2% accessory spleens are found in tail of pancreas studied by Weinad and Mangold [6] in 2003. Retroperitoneal accessory spleen may assume as retroperitoneal tumour. Ectopic spleen most of the time is confused with metastatic adenopathy or other solid tumours by radiologist. So knowledge in morphological variations of spleen is needed. It will be helpful in diagnosis, surgeries, treatment and routine clinical examinations in splenic traumas and splenomegaly.

In the present study, we found an average spleen length of 11.7 cm (range 8.1cm to13.2cm) in the Vidarbha region. Chaware PN et al [7] found average length of 9.66 cm (range 5 cm to 13 cm) in Yavatmal and Nagpur regions of Maharashtra. Naveena S (2019) [8] observed spleen length ranging between 8.5 and 21 cms. Chaudhary ML (2014) [9] observed the length of spleen varies between 6cm to 14cm with an average 9.59cm. The variations in the length of spleen may be attributed more prevalence of mild to moderate splenomegaly that affect the population of that particular region. If cadavers have splenomegaly due to any reason at time of death, this might have reflected in the study.

The average splenic breadth observed in the present study is 5.8cm with ranging between 3.5cm to7.4cm. The study by Caware PN et al [7] observed average breadth of 6.22 cm with range of 3.5 cm to 9.5 cm. Naveena S (2019) [8] observed splenic breadth ranging between 4cm to 8.5cm. Chaudhary ML (2014) [9] observed splenic breadth varying between 3.5 to 8.5cm with an average 6.58 cm. The findings of present study are mostly in tandem with the findings of other authors. The further variance may be attributed to endemic nature of diseases which generally affect the dimensions of the spleen.

We found about 90% spleens with single notch (68.33% along the superior border only, 10% along the inferior border only) and 10% spleens with multiple notches. In the cadaveric study in Jharkhand state population by Karmali NK [10] observed 7.1% with multiple notches on intermediate border. Skandalakis PN et al [11] found 78.6% spleens with notched superior border, Soyuluolu [12,13] 70%, Ungor et.al. [12] 95%, Chaudhary ML (2014) [8] 50% and Das et al.(2008) [14] 98% notched superior border. Bergman et al observed the splenic notch on the inferior border in 32% of spleens along with notch on the superior border [12]. Nayak et al (2011) [15] noted only 50% of the spleens with notches on the superior margin. The notches

present on the surface of spleen are developed due to its lobulated origin [9]. The spleen develops from mesenchymal condensation in the dorsal mesogastrium during the 6<sup>th</sup> week of gestation. The mesenchymal cells between the leaflets of dorsal mesogastrium and the cells of the coelomic epithelium of the dorsal mesentery form the early spleen(Gandhi KR et al, 2013) [9]. These notches along superior border of spleen are useful for clinicians to palpate enlarged spleen [15]. The clinicians use splenic notches to distinguish the enlarged spleen from surrounding organs [12].

The commonest shape of the spleen in our study was wedge shape (78.3%) of the spleen followed by tetrahedral (13.3%), triangular (6.7%) and irregular in 1.7%..Caware PN et al [7] observed 61.26% wedge shaped, 21.61% tetrahedral, 12.61% triangular & 3.91% irregular shaped spleen. Tenaw and Muche (2018) [16] noted 38% of triangular-shaped spleens, which was the commonest observed shape. In another study in Andhra Pradesh by , Siva & Sridhar, Soorya (2015) [17] observed 73.33% wedge shaped, 13.33% triangular, 6.67% tetrahedral, 6.67% oval shaped spleens. Naveena S (2019) [8] observed 40% triangular shaped spleens in study in Hyderabad, Telangana state population.

While discussing the Splenic parameters with other studies in literature, it is learnt that there is huge variations in the parameters. Reason behind this may be endemic diseases affecting the splenic dimensions. So it is suggested that more study samples are required from most of the regions of India for accurate analysis and knowledge.

## 5. CONCLUSION

Morphological variation is very common in spleen and varies according to the genetic, geographic, nutrition and work habits of individual and varies regions to regions of India. Morphological analysis is under reported and need to be carry out at different regions and places for obtaining more accurate data. The study is also need to focus on geographical conditions, work habits, food habits and genetic factors. So it is suggested that more study samples are required from most of the regions of India for accurate analysis and knowledge.

## CONSENT

It is not applicable.



## ETHICAL APPROVAL

The Institutional Ethic Committee has approved the following research work proposed to be carried out at Jawaharlal Nehru Medical College, DMIMS (DU) & Acharya Vinoba Bhave Rural Hospital, Sawangi (Meghe), Wardha.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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