

**MORPHOLOGICAL AND MORPHOMETRIC VARIATIONS OF SPLEEN: A CADAVERIC STUDY IN NORTH INDIAN POPULATION**NEELAM BALA<sup>1</sup>, KULBIR KAUR\*<sup>1</sup>, JAGDEV SINGH KULLAR, IPSHITA

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**ABSTRACT**

**Objective:** The aim of study is to study morphological and morphometric analysis of spleen and its clinical importance. Spleen consists of a large encapsulated vascular organ and important lymphatic tissue in the human body. Its immunological functions are being well realized. The weight, size, and shape of the spleen vary in human being with age, sex, and under different conditions in the same individual. The morphological variations are important for physicians, surgeons, and radiologists to avoid misinterpretation of the splenic variants.

**Methods:** A cross-sectional study of a total of 50 adult human cadaveric spleens was done in the Department of Anatomy Government Medical College, Amritsar, Punjab. The study observed the morphological features such as shape, anomalous fissures, and morphometric measurements such as length, breadth, thickness, and weight of all the spleen specimens.

**Results:** The wedge-shaped spleen constituted 62%, tetrahedral (30%), triangular (4%), and irregular (4%), shaped spleens. Out of 50, 60% displayed notches on the superior border of spleen and 10% on inferior border of spleen. There was no notch in 30% of the specimens. Mean length of spleen was 9.2 cm, mean breadth was 6.2 cm, and thickness was 3.08 cm, respectively. The mean weight of the spleens was 140.008 g. Anomalous fissures were 2% found on the diaphragmatic surface.

**Conclusion:** The findings of the present study will be of fundamental importance to the physicians, surgeons, and radiologists and give clues for various clinical diseases.

**Keywords:** Spleen, Shape of spleen, Splenic notches.

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**INTRODUCTION**

Spleen consists of a large encapsulated mass or vascular and lymphoid tissue situated in the upper left quadrant of the abdominal cavity [1]. The main function of the spleen is to maintain the immune system of the body, especially in fighting against disease-causing germs which enter the body through various routes [2].

Spleen has two primary lobes (the superior lobe and inferior lobe) one accessory lobe and three to five segments. The classification facilitates the surgeon to perform the resection of spleen and allow transplantation of the hemi spleen from a living related donor in human beings. Anatomical knowledge of vasculature of the splenic lobe and segments is of great clinical significance in partial resections and transplantation of the spleen.

The lobulated form of spleen in the early developmental phase is represented by notches at a later period which occur at the superior border. The spleen develops from the mesoderm and during development, different lobules are formed, which fuses with each other later on which is indicated in the form of the lobulations in adult spleen that can be seen on superior as well on inferior borders. The spleen in carnivorous is larger with notch on all the borders whereas spleen is less notches in anthropoids [3].

**METHODS**

The study was a cross-sectional study conducted in the Department of Anatomy, Government Medical College Amritsar, Punjab. A total of 50 formalin intact spleens were included. The spleens were collected during routine dissection of the donated adult human cadavers for

the undergraduate medical teaching. As per guidelines mentioned in Cunningham's Manual [4]. Various morphological features, such as shape, splenic notches, and anomalous fissure on surface of spleen, were observed. In addition, morphometric studies such as length, breadth, thickness, and weight of the spleens were recorded using measuring tape, sliding caliper, and weighing machine, respectively.

The observations relating to the shape, splenic notch, and anomalous fissures were expressed as percentages. The length, breadth, thickness, and weight were summarized by descriptive statistics (numerical) and the mean values were compared with the findings of other.

**Ethical issues**

The study was approved by the Institutional Ethics Committee.

**RESULTS**

In the current study, an examination of 50 cadaveric spleen revealed different shapes and sizes the wedge-shaped spleen constituted 62% in Fig. 1 followed by tetrahedral 30% shaped in Fig. 2 triangular (4%) in Fig. 3 and irregular (4%) in Fig. 4. As mentioned in Table 1.

The length of the spleens varied from a minimum of 6.63 cm to a maximum of 13.3 cm with a mean value of 9.2 cm. The breadth was observed to vary from 3.8 cm to 10.0 cm with a mean value of 6.2 cm. The mean thickness was 3.08 cm with the minimum and maximum limits of 1.2 cm and 5.1 cm, respectively. A mean value of 140.008 g was observed for the weight of spleen. As mentioned in Table 2.

The presence of fissure start from inferior border extend toward diaphragmatic surface shown in Fig. 8 was 2% in our study. The

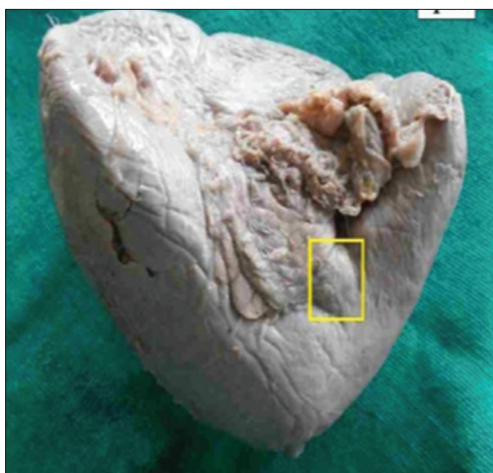


Fig. 1: Wedge shaped spleen

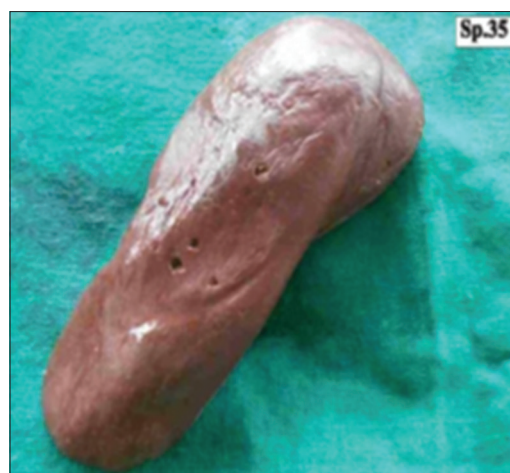


Fig. 4: Irregular shaped spleen

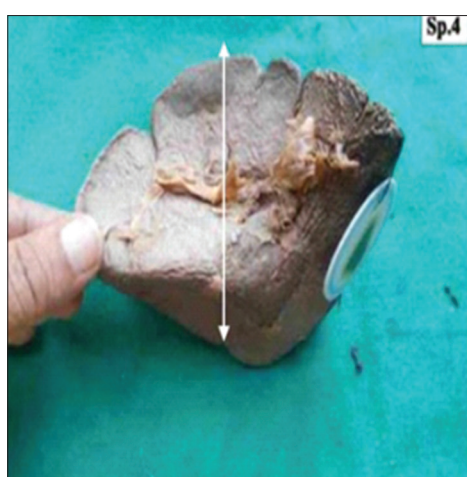


Fig. 2: Tetrahedral shaped spleen



Fig. 5: Large size spleen with absence of notches



Fig. 3: Triangular shaped spleen

congenital fissures like the one being reported by us probably result due to the improper fusion of the splenic nodules during development or due to the pressure by the nearby viscera [5].

It was concluded that a maximum 2 notched spleens were present in 14 specimen of spleen (28%) and 5 notches on spleen only in one case (out 50) shown in Fig. 8. Unnotched spleen seen in 20 specimens (40%) shown in Fig. 5.

Table 1 : Different shape of the spleen in present study (n=5)

S. No.	Shape	No. of spleens	Percentage
1	Wedge	31	62
2	Tetrahedral	15	30
3	Triangular	2	4
4	Irregular	2	4
5	Total	50	100

Table 2: Measurement of length, breadth, and thickness of spleen (n=50)

Parameter	Minimum	Maximum	Mean	SD
Length	6.32	13.3	9.2	1.4
Breadth	3.8	10.0	6.2	1.39
Thickness	1.2	5.1	3.08	0.78

## DISCUSSION

The present study noticed five different shapes of the spleen. Wedge shape was more prevalent followed by tetrahedral, triangular, and irregular shapes.

In the present study, 50 spleen were studied, and the shape of the spleen was categorized into four groups. Out of 50 spleens, 62% were wedge-shaped, 30% were tetrahedral, 4% were triangular, and 4% were irregular. As the dimension of the spleen is commonly altered

Table 3: Splenic length, breadth, and thickness in some Indian studies

S. No.	Authors	Year	Length mean±SD	Breadth mean±SD	Thickness mean±SD
1	Chaware <i>et al.</i>	2012	9.66±1.79	6.22±1.33	3.06±0.93
2	Setty and Katikireddi	2013	10.5±1.89	8.3±1.45	3.96±0.98
3	Chaudhari <i>et al.</i>	2014	9.59±1.6	6.58±1.34	4.54±0.99
4	Present study	2016	9.2±1.4	6.2±1.39	3.08±0.78

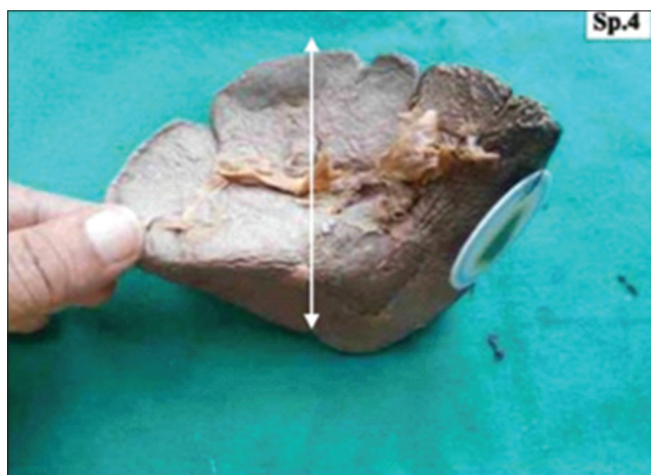


Fig. 6: Maximum breadth of spleen

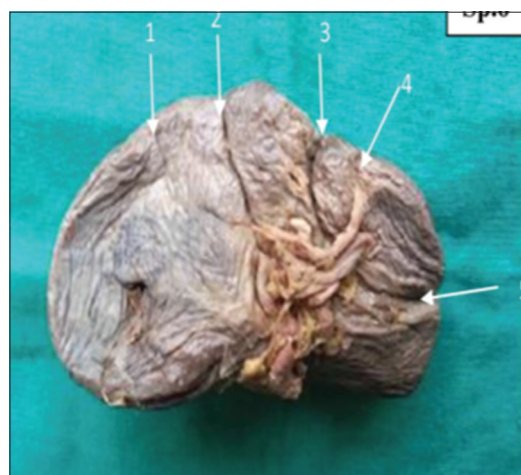


Fig. 8: Five notched spleen



Fig. 7: Fissure on inferior border

in diseases, accurate knowledge of normal shape is of considerable importance.

Hence, most of the spleens 25 specimens (50%) out of 50 cases were 8–10 cm. It was compared with previous studies of different authors, Chaudhari *et al.* 2014 found that most of the spleen 24% cases range between 8 and 10 cm and it was in consonance with the values of previous studies [6]. Chaware *et al.* 2012 found most of the spleen 40% of cases between 10 and 12 cm [7]. Setty SN and Katikireddi RS 2013 found that most of the spleens 40% of cases were between 10 and 12 cm [8]. The values of length were slightly lower than those compared with previous studies and it is due to the difference in genetic factors, body constitution, geographical conditions, feeding habits, and better socioeconomic status.

From Table 3, it was found that the breadth of the spleen according to Chaware was in between 5 and 7 cm which was 66%, Setty found breadth of most spleens 52% in between 7 and 9 cm and Chaudhari found breadth of most spleen 58% in between 5 and 7 cm. Breadth of most of spleens falls in between these values but it was variable in

different age groups. Rayhan *et al.* found that length, breadth, and width of spleen vary in different age groups, and the value of breadth was slightly lower than those compared with previous studies. This is due to the differences in genetic factors, body constitution, geographical conditions, feeding habits, and better socioeconomic status.

In the present study, the width of the spleen varied from 1.2 to 5.1 cm, mean was 3.08 cm, and standard deviation 0.78 cm. It was compared. With different authors and was in consonance with studied of other authors.

#### SUMMARY AND CONCLUSION

The present study was concluded on 50 adult human cadaveric spleens. Different morphological features were looked for and morphometric parameters were measured. The results were tabulated, scrutinized, and statistically analyzed.

Morphometric analysis of spleen seems to be under reported and need to be carried out actively, that there are morphological variations of the spleen in different individuals. Therefore, such idea of possible morphological variations should be kept in mind by the radiologists and the clinicians, especially the surgeons to avoid misinterpretation of the splenic variants and avoid unnecessary invasive procedures.

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#### CONFLICTS OF INTEREST

There were no conflicts of interest in the study.

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#### REFERENCES

- Borley NR. Abdomen and pelvis. In: Standring S, editor. Gray's Anatomy: The Anatomical Basis of Clinical Practice. 40<sup>th</sup> ed.

- United Kingdom: Churchill Livingstone; 2008. p. 1191-5.
2. Das S, Abd Latiff AA, Suhaimi FH, Ghazalli H, Othman F. Anomalous splenic notches: A cadaveric study with clinical importance. *Bratisl Lek Listy*. 2008;109(11):513-16. PMID 19205563
  3. Patil GV, Kumar S, Apoorva D, Thejeswari SJ, Sheshgiri C, Sushanth NK. Study of splenic notches in a human cadaver. *Int J Recent Adv Multidiscip Res*. 2014;1(2):1-3.
  4. Romanes GJ. The spleen. In: *Cunningham's Manual Anatomy*. 15<sup>th</sup> ed., Vol. 3. Thorax and Abdomen; 1986. p. 114-6.
  5. Sant S. *Embryology for Medical Students*. New Delhi: Jaypee Brothers' Medical Publishers, Pvt Ltd.; 2002. p. 203-4.
  6. Chaudhari DM, Maheria DP, Lakhani DC, Menezes DV. Morphological variations of human spleen and its clinical significance. *Int J Med Res Rev*. 2014;2(1):16-20. doi: 10.17511/ijmrr.2014.i01.04
  7. Chaware PN, Belsare SM, Kulkarni Y, Pandit SV, Ughade JM. The morphological variations of the human spleen. *J Clin Diagn Res*. 2012;6:159-62.
  8. Setty SN, Katikireddi RS. A cadaveric study of human splenic notches and fissures. *Int J Health Sci*. 2013;3:40-4.