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ORIGINAL ARTICLE

Morphological Variations of Quadrate Lobe of Liver: A Cadaveric Study

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ABSTRACT

Introduction: Liver is largest organ occupying the right hypochondrium, epigastrium and extending to left hypochondrium. Liver is wedge-shaped, it is concave inferiorly. Liver is divided into anatomical right and left lobes and quadrate lobe on inferior surface and caudate lobe on posterior surface. These two lobes are separated from each other by porta hepatis. Quadrate lobe is rectangular or triangular shape and is the segment IV of left lobe according to Couinaud classification. Pons hepatis means a segment of liver tissue connecting quadrate lobe with left lobe over fissure for ligamentum teres. Aim of the study was to observe morphological variations of quadrate lobe of liver in the cadaveric liver specimens.

Materials and methods: A study was done for a period of 1 year by collecting 35 formalin fixed cadaveric liver specimens from the Department of Anatomy, Adichunchanagiri Institute of Medical Sciences, B G Nagara, Dist Mandya from July 2025 - June 2026.

Results: Shape of the quadrate lobe was rectangular in 18, triangular in 9, square in 3, pear shape in 3 and irregular in 2 specimens. Quadrate lobe was absent in 2 specimens. Pons hepatis was observed in 5 specimens. There were 5 fissures seen, 4 transverse and 1 vertical.

Conclusion: Anatomical knowledge of variations such as absence, fissures and pons hepatis of quadrate lobe are important in radiological diagnosis and surgical procedures in the vicinity.

KEYWORDS

• Fissures • Couinaud Classification • Pons Hepatis • Porta Hepatis

INTRODUCTION

Liver is both exocrine and endocrine organ located in the right hypochondrium and partly extends to epigastrium and left hypochondrium. Inferior surface is concave and conforms to the shape of the adjacent viscera and other surfaces are convex.[1]

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Inferior surface of the liver shows fissures for the ligamentum teres & ligamentum venosum and quadrate & caudate lobes. Quadrate lobe is located between fissure for ligamentum teres on the left side and gall bladder fossa on right side. Caudate lobe is between fissure for ligamentum venosum and groove for inferior vena cava (IVC).[2]

Classification based on Healy and Schroy (1953) and Couinaud (1957), the liver is divided into functional right and left lobes. Segments I–IV constitute the left lobe, while segments V–VIII form the right lobe.[2]

The quadrate lobe is usually rectangular in shape. It is bounded in front by the inferior border, behind by the porta hepatis and on either side by fissure for ligamentum teres and fossa for gallbladder.[3] Functionally quadrate lobe is segment IV of left lobe (Couinaud) and receives blood supply from the left branches of hepatic artery and portal vein.[4] Quadrate lobe is related to structures from above downwards to right free margin of lesser omentum with its contents, pyloric part of stomach and 1st part of duodenum in the middle, transverse colon in lower part when stomach is empty.[5] Pons hepatis is a variation wherein quadrate lobe is connected to the left lobe across the fissure for the ligamentum teres. It was first described by Von Haller in 1743.[6]

Aims and objectives: To study the morphological variations of quadrate lobe such as shape, fissures, absence of lobe and pons hepatis in the cadaveric liver specimens.

MATERIALS AND METHODS

A study was conducted for a period of 1 year by collecting 35 formalin fixed cadaveric liver specimens from the Department of Anatomy, Adichunchanagiri Institute of Medical Sciences B G Nagara, Dist Mandya in Karnataka State from 1st July 2025 to 30 June 2026. 35 liver specimens were obtained from Anatomy department museum and liver specimens eviscerated during dissection.

Inclusion criteria:

1. Liver specimens irrespective of the age and gender.
2. Intact liver specimens.

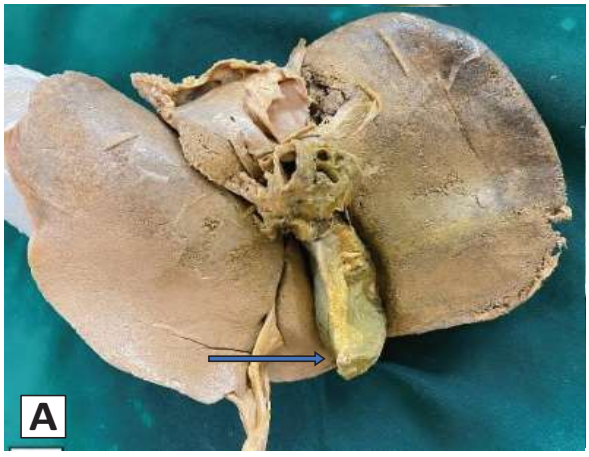
Exclusion criteria:

1. Liver specimens which were damaged during dissection.
2. Any abdominal surgery or trauma, surgically resected liver specimens.
3. Specimens with distorted shape during preservation and storage.

Each liver specimen was cleaned and placed in the anatomical position to facilitate visualization of the visceral and diaphragmatic surfaces. Quadrate lobe was studied for shape, variations such as absent lobe, pons hepatis and presence of fissures.

RESULTS

Totally 35 liver specimens were studied. Shape of the quadrate lobe was, rectangular in 18 (51.43%), triangular in 9 (25.71%), square in 3 (8.57%), pear shape in 3 (8.57%) and irregular in 2 (5.71%) specimens. 2 specimens had very much narrow lobe. Quadrate lobe was absent in 2 (5.71%) specimens, pons hepatis was observed in 5 (14.29%) specimens. There were 5 (14.29%) fissures seen over the lobe, 4 transverse and 1 vertical. Four specimens were showing bilobed appearance due to transverse fissure.





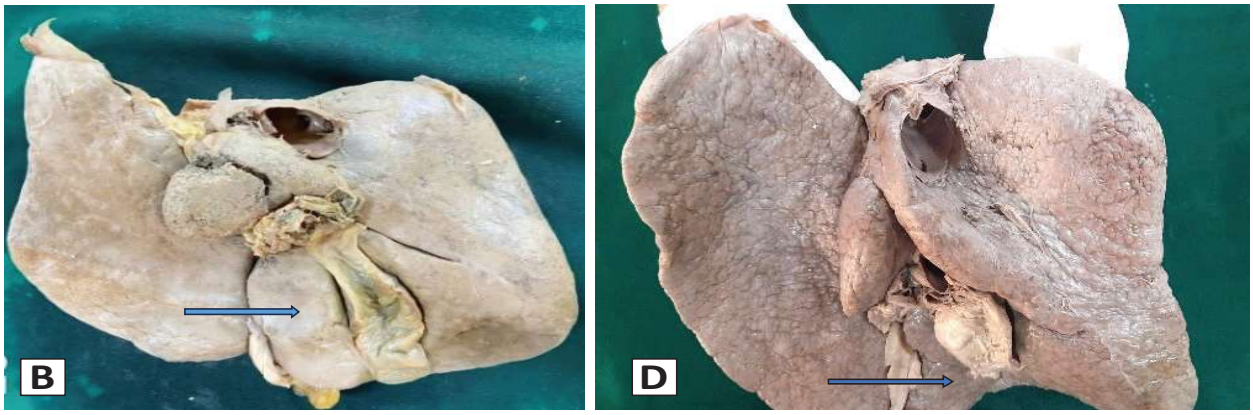


Figure 1: Showing different shape of quadrate lobe **(blue coloured arrows); A)** Triangular **B)** Rectangular **C)** Narrow **D)** Irregular

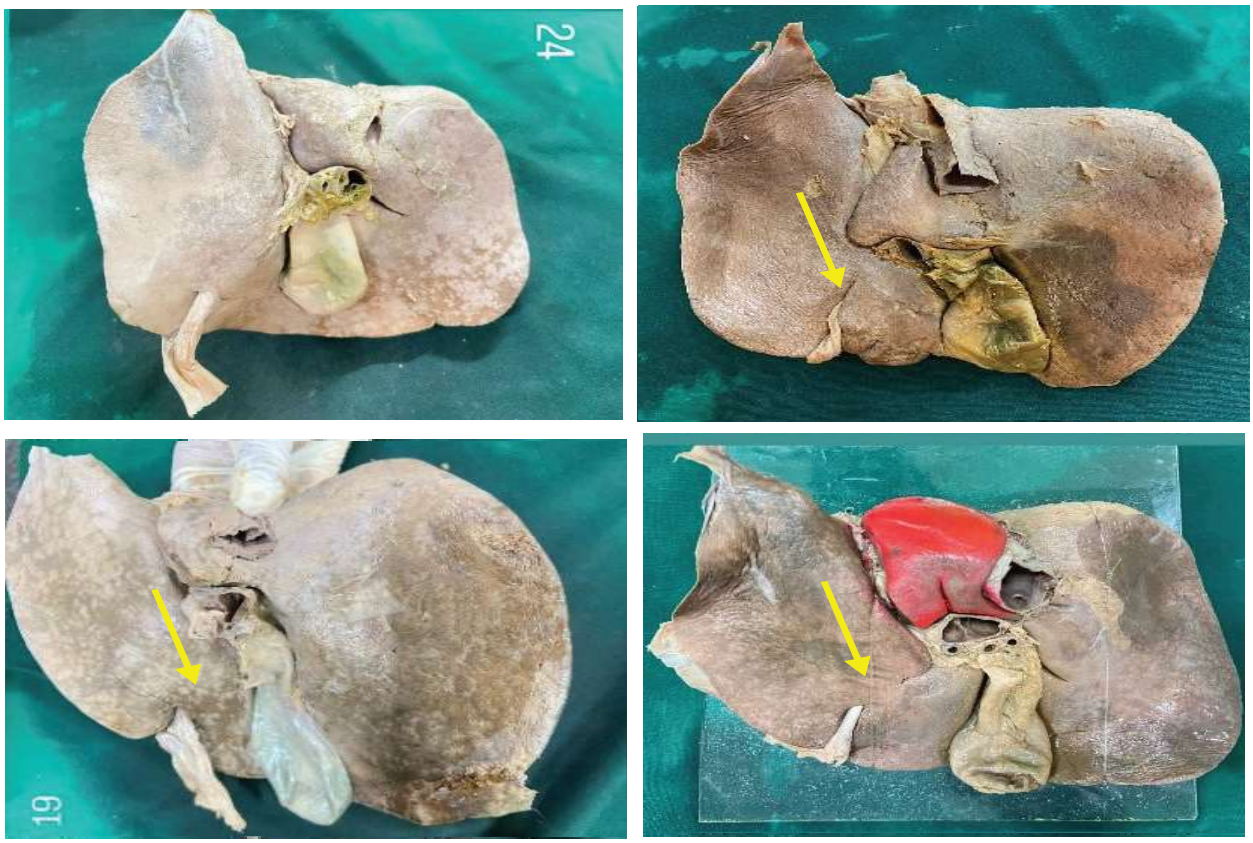


Figure 2 Showing pons hepatis (yellow-coloured arrows)



Figure 3: Showing absent lobe

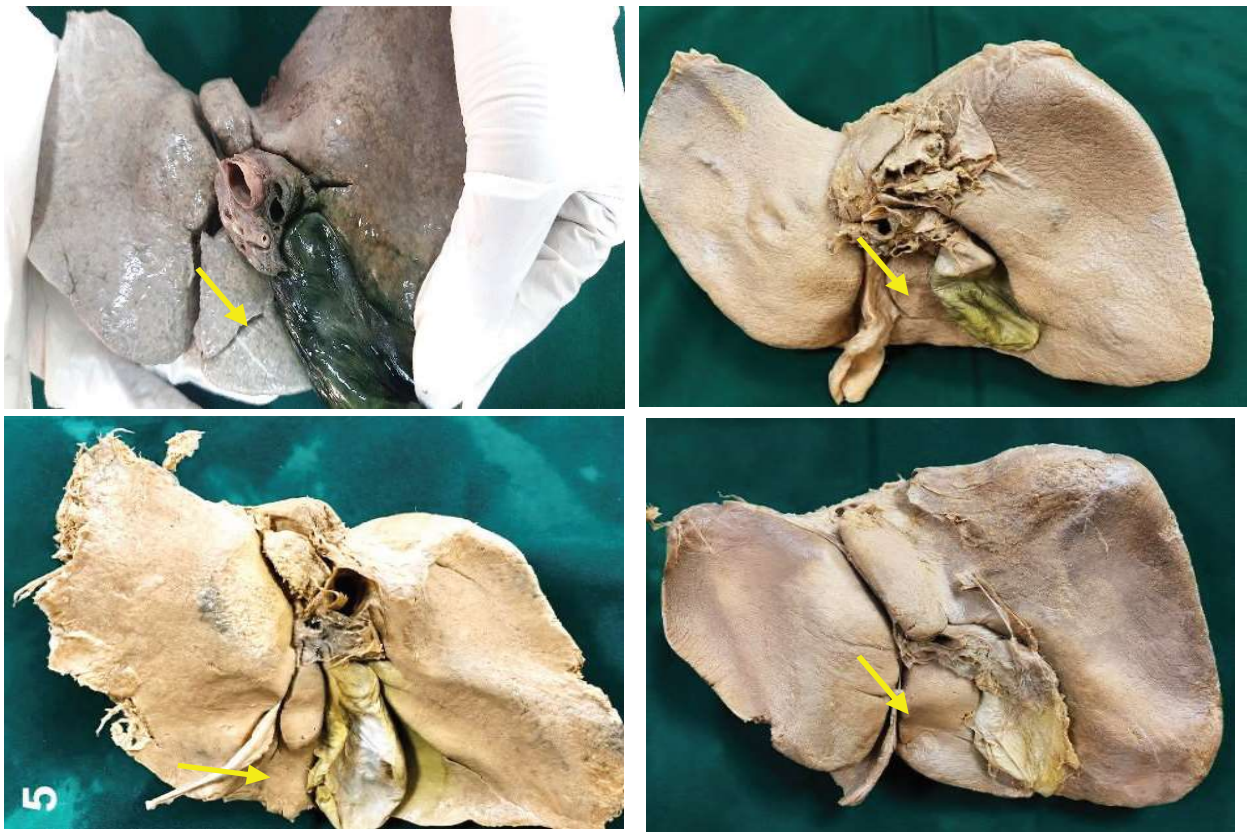


Figure 4: Showing transverse fissure on quadrate lobe dividing upper and lower lobes

DISCUSSION

There is dearth of literature on the quadrate lobe unlike caudate lobe possibly, due to few clinical and surgical importance[12]. Quadrate lobe variations observed in the present study include absence of lobe, pons hepatis and fissures. Variations in human liver may be acquired or congenital. Congenital types include absence of lobe or presence of accessory lobe. Congenital abnormalities may be due to abnormal or excessive development, sometimes due to abnormalities of diaphragm.[7]

Accessory fissures

Accessory fissures are mistaken for macronodular liver on CT. Collection of fluid in fissure could mimic hepatic cyst or abscess. Knowledge of these variations help radiologist and surgeon from misdiagnosis and avoid surgical complications.[7] In situations of malignancy of any organs in the abdominal cavity there can be chances of spillage of tumor cells into peritoneal cavity and into fissures mimic intrahepatic focal lesions.[8,12] Many authors have described horizontal & oblique fissure over the lobe dividing the lobe into superior and inferior.

Chaudhary *et al*[8] reported transverse fissures in 7.5% liver specimens. Sambhav K *et al*[12] reported 7 (1.22%) fissures in 40 specimens. Saini R P *et al*[2] reported 6 (9.83%) transverse fissures in 61 specimens. In the present study there were 5 (14.28%) fissures, 1 vertical & 4 transverse fissures were observed. Joshi M M *et al*[9] reported vertical fissures 5%.

Table 1: Comparison of variations of Quadrate lobe with other studies

Author	Year Region	Sample Size	Absent lobe	Transverse fissure	Vertical fissure	Pons hepatis
Chaudhary H J[8]	2017, Gujarat	80	-	6 7.5%	-	1 1.25%
Joshi M M[9]	2017, Maharashtra	100	2 2%	34 34%	5 5%	13 13%
Mehore T[10]	2017, Ethiopia	33	2 6.06%	1 3.03%	1 3.03%	3 9.0%

table cont....

Author	Year Region	Sample Size	Absent lobe	Transverse fissure	Vertical fissure	Pons hepatis
Seeja P J[11]	2023, Tamil Nadu	50	-	-	-	7 14%
Sambhav K *et al*[12]	2023 Rajasthan	40	1 2.5%	2 5%	5 12.5%	2 5%
Katare P[4]	2023, Rajasthan	30	-	1 3.33%	-	3 10%
Saini R[2]	2025, Rajasthan	61	3 4.91%	5 8.2%	-	7 11.47%
Present	2026, Karnataka	35	2 5.71%	4 11.43%	1 2.85%	5 14.2%

Pons hepatis

Pons hepatis means a hepatic bridge wherein a segment of hepatic tissue connecting quadrate lobe with the left lobe obscuring the fissure for ligamentum teres partly or completely. And there may be difficulty in taking correct diameter of right and left lobes.[8,12] Joshi M M *et al*[9] reported 13%, Seeja P J *et al*[11] reported 14% and present study 14.2% and is comparable with these studies. Pons hepatis was shown less in the following studies, Mehore T[10] 9%, Sambhav K *et al*[12] 5% and Chaudhary H *et al*[8] 1.25%.

According to a study done by Chin J *et al*[6] pons hepatis is referred as hepatic tissue that surrounds IVC partial or completely. Among the study of 33 cadavers belonging to Caucasian origin in New York, 12 specimens had features of pons hepatis of encapsulation of IVC and no variation of quadrate lobe was seen.

Absent quadrate lobe

A small buried or absent quadrate lobe could induce errors and confusion in radiological diagnosis since the gallbladder fossa would be an approximation to the fissure for ligamentum teres.[12] Absence of quadrate lobe was observed 5.71% in the present study and is comparable with study reported by Mehore T *et al*[10] 6.06% and Saini R *et al*[2] 4.91%, Whereas less in the study reported by Sambhav K *et al*[12] 2.5%, Joshi M M *et al*[9] 2%. Absent lobe was not reported in studies Chaudhary H *et al*[8], Seeja P J '[11] and Katare P.[4]

During radiological studies such as Ultrasonography, CT, MRI some of these morphological changes of liver might be mistaken for pseudo-lesions, focal fatty infiltrations and may not represent true parenchymal lesions.[8] Portal venous hypoperfusion and cirrhosis of liver may cause atrophy of quadrate lobe.[12]

Shape of quadrate lobe

Rectangular shape was commonest in studies reported by Saini R *et al*[2] 40.98%, Joshi M M *et al*[9] 68% and Sambhav K *et al*[12] 25%. And in the present study quadrangular shape was 51.43% comparable studies mentioned, except Sambhav K *et al.*[12] The following table 2 shows the % of other shapes include square, pyramidal, pyriform, irregular and narrow.

Table 2: Comparison of shapes of Quadrate lobe

Author	Year Region	Sample	Quadrangular	Triangular	Others	Absent lobe
Saini R *et al*[2]	2025 Rajasthan	61	25 40.98%	13 21.31%	20 32.79%	3 4.9%
Joshi M M *et al*[9]	2017 Maharashtra	100	68 68%	16 16%	14 14%	2 2%
Kumar S *et al*[12]	2023 Rajasthan	40	10 25%	7 17.5%	16 40%	1 2.5%
Present	2026 Karnataka	35	18 51.43%	5 14.28%	8 22.86%	2 5.71%

CONCLUSION

There are few studies reported pertaining to quadrate lobe of liver. The present study high light the morphological variations might be

causing difficulties in radiological diagnosis. Absence of lobe, fissures over the lobe and pons hepatis were important variations observed in the study. Absence of lobe is important during laparoscopic cholecystectomy.

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