Section: Anatomy

Original Research Article

A STUDY ON THE MORPHOLOGICAL VARIATIONS OF UMBILICAL FISSURE IN CADAVERIC LIVER

Nianghoih[1], Rupak Jyoti Baishya[2], Satyajit Mitra [3], Joydev Sarma[4]

[1]Post Graduate Trainee, Department of Anatomy, Gauhati Medical College and Hospital, India.
[2]Assistant Professor, Department of Anatomy, Gauhati Medical College and Hospital, India.
[3]Professor & Head, Department of Anatomy, Gauhati Medical College and Hospital, India.
4 Professor, Department of Anatomy, Gauhati Medical College and Hospital, India.

Received : 19/01/2026
Received in revised form : 10/03/2026
Accepted : 29/03/2026

Keywords:
Ligamentum Teres, Umbilical Fissure, Liver Parenchyma.

Corresponding Author:
Dr. Rupak Jyoti Baishya,
Email: drrupak80@gmail.com

DOI: 10.47009/jamp.2026.8.2.213

Source of Support: Nil,
Conflict of Interest: None declared

Int J Acad Med Pharm
2026; 8 (2); 1174-1177

ABSTRACT

Background: In human liver, umbilical fissure is marked anteriorly by attachment of falciform ligament and inferiorly by round ligament of liver. It may also be covered by a bridge of tissue extending between segments III and IV, thereby forming a narrow groove on visceral surface of the liver that receives ligamentum teres hepatis. In this study, an attempt will be made to evaluate and document variations of umbilical fissure encountered in a series of cadaveric dissection. **Materials and Methods:** This study was conducted in the Department of Anatomy, Gauhati Medical College and Hospital, Guwahati, on a total of 40 formalin fixed human livers over a period of one year. The morphological variations of umbilical fissure were noted and documented. Accordingly, they were categorised under four types:

- Type I - refers to normal anatomy of umbilical fissure where there is a continuous, open groove.
- Type II - umbilical fissure is covered by a fibrotic band devoid of liver parenchyma.
- Type III - liver parenchyma projects to the umbilical fissure. This does not completely cover the umbilical fissure but interrupts the normal anatomical continuity of the fissure.
- Type IV - bridge of liver parenchyma covers the umbilical fissure.

Results: In our study, Type I is found in 18 (45 %) liver specimens whereas Type II is seen in 6 numbers of liver (15%). In 13 numbers (32.5%) of specimens, Type III are found and Type IV is noticed in 3 numbers (7.5%) of liver. **Conclusion:** It is observed that 18 numbers (45 %) of liver specimens studied shows normal anatomical variant of umbilical fissure whereas 22 numbers (55%) show variations. In this study we shall try to enhance the understanding and knowledge of these variants. This may aid surgeons in planning surgical interventions as well as providing awareness among clinicians and imaging specialists.

INTRODUCTION

Liver occupies predominantly the right hypochondrium and epigastrium. It frequently extends into left hypochondriac region.

In a human liver, umbilical fissure is a long narrow groove on the visceral surface of liver that receives ligamentum teres hepatis. It is marked anteriorly by attachment of falciform ligament and inferiorly by round ligament,[1] wherein it may be covered by a bridge of tissue extending between segment III and segment IV.[1]

The development of liver is a complex process which starts in the middle of 3rd week of intrauterine life.[2] Hence, it results in various anomalies and variations as have been documented in previous studies.

The umbilical fissure is used as a landmark by hepatobiliary surgeons particularly during liver resections and also is used by radiologists particularly for vascular assessments and also in diagnosis of pneumoperitoneum.

Hence, a thorough understanding of anatomy of umbilical fissure and its commonly encountered variations is vital.

MATERIALS AND METHODS

After obtaining Ethical Clearance, the study was conducted on 40 numbers of formalin fixed human livers, in the Department of Anatomy, Gauhati Medical College and Hospital, Guwahati, over a period of one year. Liver specimens were obtained

ISSN (O): 2687-5365; ISSN (P): 2753-6556

from officially donated bodies at the Department of Anatomy and also from unclaimed bodies during autopsies conducted by Department of Forensic Medicine, Gauhati Medical College & Hospital.

Inclusion Criteria: Adult human cadaveric liver with no gross morphological lesions or damage.

Exclusion Criteria: Adult human cadaveric liver with gross external surface lesions or damage that can confound morphological studies has been excluded from this study.

The different morphological variations were noted and documented with special attention to the characteristics of umbilical fissure and its immediate relations with segment III, segment IV and ligamentum teres hepatis.

All liver specimens were observed and verified by three Anatomists at different times and there was no observer discrepancy by consensus.

RESULTS

In this present study, we identified four morphological types of umbilical fissure. Accordingly, the observed variants of umbilical fissure are categorised under four main types:

Type I – Umbilical fissure is a continuous, open groove, extending from anterior liver edge to left side of transverse fissure. This variant is considered as normal anatomical variant.

Type II - A fibrotic band without liver parenchyma covers the umbilical fissure.

Type III - Liver parenchyma projects to the wall of umbilical fissure. This variant does not completely cover the fissure but interrupts the normal anatomical continuity of the fissure.

Type IV - A bridge of liver parenchyma covers umbilical fissure.

Of the 40 liver specimens studied, 18 numbers (45%) of specimens showed normal, continuous open groove for umbilical fissure (Type I), whereas 22 numbers (55%) showed different types of variations of umbilical fissure. [Table 1]

Table 1: Observed distribution of morphological variations in the umbilical fissure following Cawich et al. [3]

Type	Total no. of specimen	No. of cases with variation	Percentage of occurrence (%)
I	40	18	45
II	40	6	15
III	40	13	32.5
IV	40	3	7.5

Table 2: Comparison with previous studies

References	No. of specimen	Type I	Type II	Type III	Type IV
Cawich et al. (2021) [3]	69	44.9%	1.5%	20.5%	33.4%
Katara et al. (2023) [5]	30	Not specified	3.3%	Not specified	10%
Chauhan et al. (2024) [8]	52	Not specified	Not specified	Not specified	9.6%
Singh et al. (2024) [4]	100	Not specified	6%	Not specified	9%
Dnyanesh et al. (2025) [13]	43	51.1%	2.3%	9.3%	37.1%
Present study	40	45%	15%	32.5%	7.5%

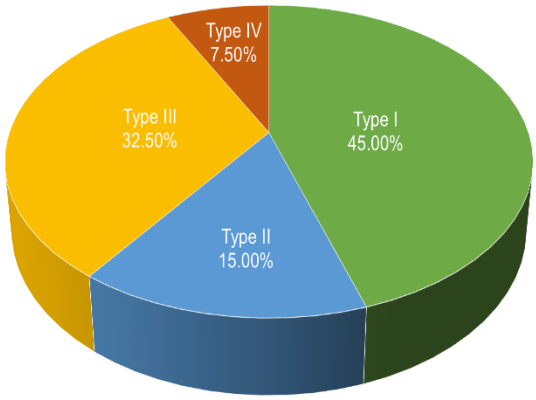

Figure 1: Pie diagram showing percentage distribution of four types of variations in umbilical fissure

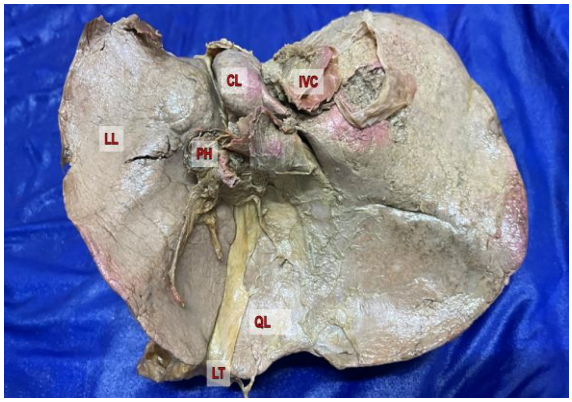

Figure 2: Type I - Umbilical fissure is a continuous open groove. LL: left lobe, PH: porta hepatis, CL: caudate lobe, IVC: inferior vena cava, LT: ligamentum teres, QL: quadrate lobe

ISSN (O): 2687-5365; ISSN (P): 2753-6556

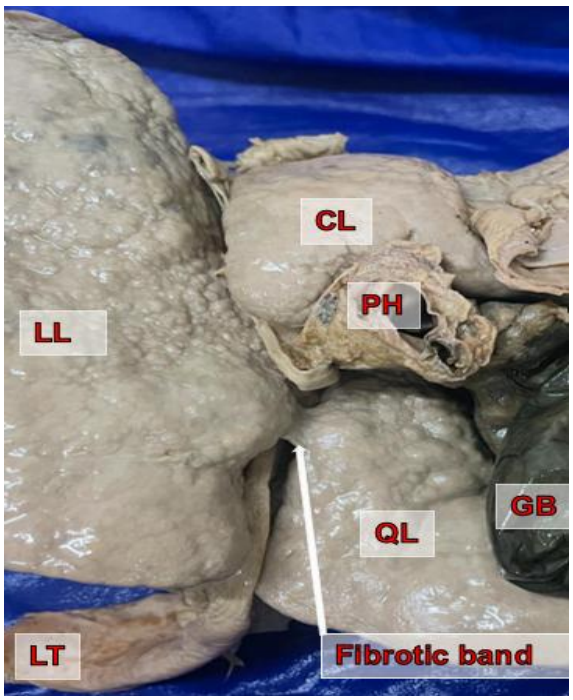

Figure 3: Type II - A fibrotic band without liver parenchyma covers the umbilical fissure. LL: left lobe, PH: porta hepatis, CL: caudate lobe, GB: gall bladder, LT: ligamentum teres, QL: quadrate lobe

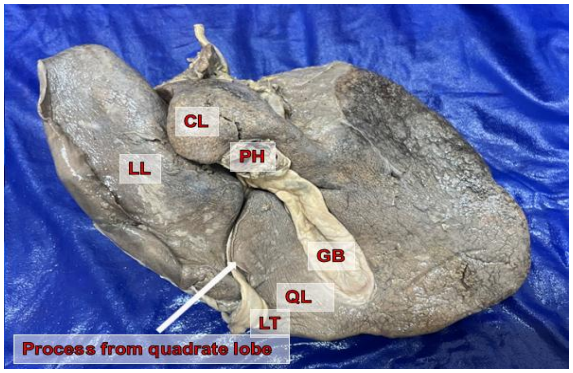

Figure 4: Type III - Liver parenchyma projects from the lateral wall of the umbilical fissure but does not completely cover the fissure. LL: left lobe, PH: porta hepatis, CL: caudate lobe, GB: gall bladder, LT: ligamentum teres, QL: quadrate lobe

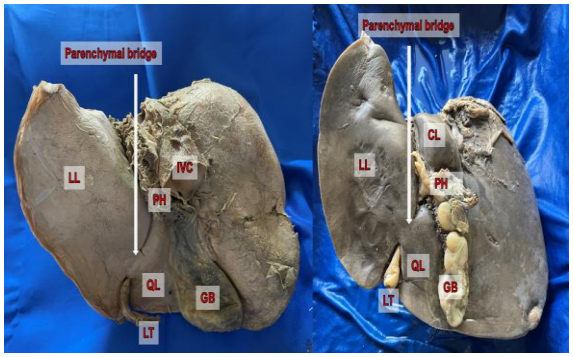

Figure 5: Type IV - A bridge of liver parenchyma completely covers the umbilical fissure. LL: left lobe, PH: porta hepatis, CL: caudate lobe, GB: gall bladder, LT: ligamentum teres, QL: quadrate lobe, IVC: inferior vena cava

DISCUSSION

The variations of umbilical fissure that receive ligamentum teres have been documented by previous studies. Additionally, published literatures used different terminologies to describe it. However, on detailed review of these literatures and incorporated images, we are able to obtain data for comparisons. [Table 2]

Type I is present in 45% of our studied specimens (Figure 2) coming to almost comparable results with findings of Cawich et al,[3] at 44.9% in Jamaican population. This is considered a normal variant by Cawich et al,[3] Dnyanesh et al. observed it in 51.1%.[13]

Type II variant, in our study, is observed in 15% (Figure 3). This variation was found in only 1.5 % by Cawich et al,[3] which comes close to the findings of Dyanesh et al. at 2.3%.[13] The same was observed in 6% by Singh et al,[4] whereas Katara et al. observed it at 3.3%.[5]

Type III variant accounts for 32.5% of the specimens in this study (Figure 4). The same is seen with a prevalence of 20.5% in a study done by Cawich et al,[3] whereas Dyanesh et al,[13] found it in 9.3%.

The narrowing of the umbilical fissure by the liver parenchymal projections in this variety may be misdiagnosed as liver tumours.[6] Such parenchymal projections may also result in incorrect localisation of focal lesions by sonography or C.T. during radiological procedure.[7] Such variant may also present technical difficulty for vascular surgeons while performing Rex Shunt.[3] Air in the fissure for ligamentum teres is used by radiologists as a delicate marker of pneumoperitoneum, thus presence of Type III may obscure accurate diagnosis.[12]

Type IV variation shows variable incidences ranging from 9% to 37.1%. In this study, it is found in 7.5% of our studied specimens. [Figure 5] Katara et al,[5] observed it at 10% which comes close to the findings of Chauhan et al,[8] and Singh et al,[4] which are at 9.6% and 9% respectively. Dyanesh et al,[13] noted it in 37.1% whereas the same was observed at 33.4% by Cawich et al. [3]

This particular variant often poses difficulty during Doppler assessment of umbilical segment when preparing for Rex Shunt.[9] Liver surgeons during laparoscopic procedure use it as a landmark to plan liver resections.[10] Besides, ligamentum teres hepatis is used as a handle to manipulate liver. Such manoeuvre may cause traumatic injury to liver parenchyma in situation where Type IV is present.[3] Furthermore, it has been documented that peritoneal metastasis could be hidden within this tunnel, formed as a result of presence of Type IV variant.[11] Such variant may also result in diagnostic confusion, as air in the fissure for ligamentum teres is used as a subtle indicator of pneumoperitoneum.[12]

ISSN (O): 2687-5365; ISSN (P): 2753-6556

CONCLUSION

From this study we can conclude the substantial impact of several morphological variants of the fissure for ligamentum teres hepatis. Findings from this study may facilitate sound radiological diagnosis and improvement in interventional procedures. Furthermore, this may enhance surgical planning and execution, particularly in hepatobiliary surgery and laparoscopic intervention.

Limited research has been carried out on the umbilical fissure despite its clinical significance. More study representing a wider population base is desired for enhanced insight and representation of the variations.

Conflict of interests: None

REFERENCES

1. Standring S, editor. Gray's anatomy: the anatomical basis of clinical practice. 42nd ed. London: Elsevier, p.1205-1215; 2020.
2. Sadler TW. Langman's medical embryology. 12th ed. Philadelphia, PA: Lippincott Williams & Wilkins, p. 217–219; 2012.
3. Cawich SO, Gardner MT, Shetty R, Lodenquai P, Ramkissoon S, Ho P, Chow A. Clinically oriented classification of anatomic variants of the umbilical fissure for ligamentum teres in the human liver. Cureus. 2021;13(6):e15460. doi:10.7759/cureus.15460.
4. Singh H, Singh R, Singh RK, Sehgal G, Dewan RK. An analysis of the anomalous fissure of the ligamentum teres hepatis: A morphological perspective in the North Indian population. Cureus. 2024;16(4):e58984. doi:10.7759/cureus.58984.
5. Katara P, Sharma RK, Sharma Y, Sharma D. A morphological study of human cadaveric liver variations along with its surgical and radiological importance. Int J Acad Med Pharm. 2023;5(5):54-57. doi:10.47009/jamp.2023.5.5.11.
6. Onitsuka A, Katagiri Y, Miyauchi T, Shimamoto T, Mimoto H, Ozeki Y. Metastatic hepatoma originating from the pons hepatis presenting extrahepatic growth—classification of different patterns covering Rex's recessus. Hepatogastroenterology. 2003;50(49):235-7.
7. Auh YH, Rubenstein WA, Zirinsky K, Kneeland JB, Pardes JC, Engel IA, et al. Accessory fissures of the liver: CT and sonographic appearance. Am J Roentgenol. 1984;143(3):565-572. doi:10.2214/ajr.143.3.565.
8. Chauhan HM, Modi HH, Rathod JB, Prajapati HK. Morphological study of human cadaveric livers and its clinical significance. Cureus. 2024;16(2):e53873. doi:10.7759/cureus.53873.
9. Puppala S, Patel J, Woodley H, Alizai NK, Kessel D. Preoperative imaging of left portal vein at the Rex recess for Rex shunt formation using wedged hepatic vein carbon dioxide portography. J Pediatr Surg. 2009;44(10):2043-2047. doi:10.1016/j.jpedsurg.2009.06.004.
10. Cawich SO, Gardner MT, Barrow M, Barrow S, Thomas D, Ragoonanan V, et al. Inferior hepatic fissures: anatomic variants in Trinidad and Tobago. Cureus. 2020;12(5):e8369. doi:10.7759/cureus.8369.
11. Sugarbaker PH. Pont hapatique (hepatic bridge): an important anatomic structure in cytoreductive surgery. J Surg Oncol. 2010;101(3):251-252. doi:10.1002/jso.21478.
12. Cho KC, Baker SR. Air in the fissure for ligamentum teres: new sign of intraperitoneal air on plain radiographs. Radiology. 1991;178(2):489-492.
13. Dnyanesh S, Neginhal D, Dnyanesh DK, Bhimalli S. Fissure for ligamentum teres hepatis: a descriptive anatomical study of variations in cadaveric livers. J Anat Soc India.2025;74(3):231–235. doi:10.4103/jasi.jasi_1_25.

ISSN (O): 2687-5365; ISSN (P): 2753-6556