

## Research Article



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## ANALYSING ANATOMICAL MORPHOMETRY AND MORPHOLOGY OF FISSURES ON THE SURFACE OF LIVER

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### ABSTRACT

**Background:** There are fissures on the liver's many surfaces, including the porta hepatis, ligamentum venosum fissure, and/or ligamentum teres hepatis, which are frequently observed on the liver's visceral surface.

**Aim:** The objective is to evaluate the morphology and anatomical morphometry of the liver's surface fissures in cadaveric sections.

**Methods:** Thirty liver specimens from cadavers frozen in 10% formalin were obtained from regular undergraduate dissection sessions for the study. The depth, breadth, and length of the fissures were measured for morphometry, while the shape, content at the base of the fissure, and any other related characteristics were measured for morphology. A scale, divider, and thread were used for each measurement.

**Results:** The ligamentum teres hepatis fissure's average depth, breadth, and length were 1.9 cm, 4.5 mm, and 5.1 cm, respectively, and were positioned either linearly or occasionally obliquely. The ligamentum venosum fissure was curvilinear and positioned vertically, with typical dimensions of 2.5 cm for depth, 7 mm for breadth, and 6.1 cm for length.

The porta hepatis's circumference measured 10.6 cm and had an oval to elliptical shape. Rouviere's sulcus, also known as Gan's fissure, was curvilinear and observed in 76.6% of the individuals. Other accessory fissures were observed as variations on the posterior surface of the right hepatic lobe, aside from Gan's fissure.

**Conclusion:** The current study comes to the conclusion that fissures on the liver's surface are essential markers for evaluating and identifying the vascular systems during various surgical operations and imaging examinations. During radiological evaluations and surgical procedures, radiologists and surgeons can benefit from the morphometric and morphological differences seen.

**Keywords:** Accessory hepatic fissures, Fissure of Gans, Fissure for ligamentum teres hepatis, Porta hepatis

### INTRODUCTION

The existence of different cracks on the different surfaces of the liver is a distinctive feature. The visceral and posterior surfaces are the main locations for these fissures. On the visceral and posterior surfaces of the liver, there are three visible minor fissures and three big fissures that are not visible. The surface of the liver may have obvious accessory cracks.<sup>1</sup>

On the visceral surface of the liver, fissures for the ligamentum venosum, porta hepatis, and ligamentum teres hepatis are frequently observed. The liver's visceral surface has a deep fissure that runs almost vertically. The ligamentum venosum and ligamentum teres fissures are located in the top and lower halves of this fissure, respectively.<sup>2</sup>

Umbilical fissure is another term for ligamentum teres hepatis, while fissure for ligamentum venosum is also referred to as venous fissure. Liver arteries and ducts pass via a transverse fissure with an oval contour that is seen close to the center of the visceral surface. The porta hepatis is the name given to this fissure. In addition to these fissures, there are further fissures known as supplementary fissures that are not frequently observed on the surfaces of the liver.<sup>3</sup>

Rouviere's sulcus, another name for the fissure of Gan, is one such accessory fissure. In anatomical investigations, radiological interpretations, and surgical navigation, these fissures are essential. It is essential to evaluate liver surface fissures in a thorough morphometric and morphological manner.<sup>4</sup>

Therefore, the purpose of this study was to evaluate the anatomical morphometry (depth, breadth, and length) and morphology of fissures (content, related characteristics, and form) on the liver's surface in cadaveric slices.

## **MATERIALS AND METHODS**

The goal of the current cadaveric anatomical study was to evaluate the anatomical morphometry (depth, breadth, and length) and morphology of fissures (content, related characteristics, and form) on the liver's surface in cadaveric sections. The Institute's Department of Human Anatomy provided the study subjects.

60 liver samples from the cadavers were evaluated for the study. All of the study's liver specimens were obtained from undergraduate students in the anatomy dissection hall. Before being studied, all of the obtained samples were fixed in 10% formalin.

The measurements were made using the scale, divider, and thread. For width of the fissures, it was measured using a scale and a divider and at the middle of the fissure. For length of the fissure in case of ligamentum teres, it was assessed from the inferior border of the liver and extended up to the cranial limit of the liver.

For the assessment of the length of the fissure for ligamentum venosum, it was measured from the cranial end of the liver and along the superior surface of the liver till the caudal limit of the liver. A thread was used to measure the porta hepatis fissure's circumference. Using a scale, divider, and thread, the length and breadth of the accessory fissures were measured.

## **RESULTS**

Assessing the anatomical morphometry (depth, breadth, and length) and morphology of fissures (content, related characteristics, and form) on the surface of the liver in cadaveric sections was the goal of the current cadaveric anatomical investigation. Thirty liver specimens from cadavers that were preserved in 10% formalin and obtained from students' regular dissection lessons were evaluated for the study. Morphometry was measured as the fissures' depth, breadth, and length, while morphology was measured as the fissure's form, any related characteristics, and any content at the base of the fissure, if any. A scale, divider, and thread were used for every measurement.

A ligamentum teres hepatis fissure, also called an umbilical fissure, was observed in 100% (n=60) of the cadaveric specimens. The ligamentum teres hepatis is a deep groove that extends from the inferior border of the liver to the left end of the porta hepatis. It was positioned obliquely and vertically and appeared to be a linear form. Table 2 reports that the average dimensions were 4.9 cm by 4.3 mm by 1.7 cm. In 20% (n=12) of the research specimens, it was encircled by pons hepatis (liver tissue). In a few instances, the bridging tissue filled the upper third of the fissure, and in these patients, a little terminal portion of about 1.5 cm was visible.

According to the study's findings, a ligamentum venosum fissure, also referred to as a venous fissure, was observed on the visceral surface between the left and caudate lobes of the liver. It had two layers of lesser omentum and ligamentum venosum in 100% (n=60) of the specimens (Table 1). It was angled and curved. Two specimens showed an aberrant branch from the left hepatic artery. The porta hepatis, the hilum of the liver where the liver's ducts and arteries travel, is positioned transversely between the caudate and quadrate lobes of the liver. Porta hepatis was oval to elliptical in form and was seen in 100% (n = 60) of the specimens.

Additionally, Rouviere's sulcus, also known as the Fissure of Gan's, was observed in 76.6% of cases. It was curved in form and stretched from the right end of the porta hepatis to the posterior surface of the right lobe of the liver. Mostly, it was positioned obliquely. Thirty percent of the liver specimens had accessory fissures other than Gan's fissure. The visceral surface of the liver's right lobe was where these cracks were mostly seen. The average measurements were 3.3 cm for length, 1 mm for breadth, and 1 mm for depth.

## **DISCUSSION**

Thirty liver specimens from cadavers that were preserved in 10% formalin and obtained from regular undergraduate dissection sessions were evaluated in this study.

The depth, breadth, and length of the fissures were measured for morphometry, and the fissure shape, any related characteristics, and any content at the base of the fissure, if any, were measured for morphology. A scale, divider, and

thread were used for every measurement. The strategy was similar to earlier research by Kulkarni JP et al. (2025) and Deshatty DD et al. (2021), where the scientists similarly examined the existence of fissures on the liver's surface anatomically.

According to the study's findings, ligamentum teres hepatis, also referred to as an umbilical fissure, was present in 100% (n=60) of the cadaveric specimens. It is a deep groove that runs from the inferior border of the liver to the left end of the porta hepatis.

It was seen as a linear shape and was placed vertically and obliquely. Table 2 reports that the average dimensions were 4.9 cm by 4.3 mm by 1.7 cm. In 20% (n=12) of the research specimens, it was encircled by pons hepatis (liver tissue). In a few instances, the bridging tissue filled the upper third of the fissure, and in these patients, a little terminal portion of about 1.5 cm was visible. These findings were in line with those of Lazarus L et al. (2018) and Singh M et al. (2017), who also reported findings that were comparable to the current study in their respective investigations. On the visceral surface, a ligamentum venosum fissure, also referred to as a venous fissure, was shown to stretch between the left and caudate lobes of the liver.

With ligamentum venosum and two layers of lesser omentum as its contents, it was observed in all 100% (n=60) specimens (Table 1). It was obliquely positioned and curved. Two specimens had an abnormal branch from the left hepatic artery. The porta hepatis, the hilum of the liver where the liver's ducts and veins travel, is positioned transversely between the caudate and quadrate lobes. Porta hepatis was oval to elliptical in form and was seen in 100% (n=60) of the specimens. These results were consistent with those of Neginhal DD et al. (2019) and Saha et al. (2023), whose findings for Neginhal DD and porta hepatis were comparable to those of the current investigation.

According to the study's findings, Rouviere's sulcus, also known as the Fissure of Gan's, was observed in 76.6% of instances. It had a curved form and stretched from the right end of the porta hepatis to the posterior surface of the right lobe of the liver. The placement was mostly oblique. Thirty percent of liver specimens had accessory fissures other than the Gan's fissure. These cracks were mostly found on the visceral surface of the liver's right lobe. The average depth, breadth, and length were 1 mm, 3.3 cm, and 1 mm, respectively. These findings were consistent with those of Rong S et al. (2016) and Singh H et al. (2024), who also provided data for Rouviere's sulcus that were comparable to the current study.

## CONCLUSION

The current study suggests, taking into account its limitations, that fissures visible on the liver's surface are essential markers for evaluating and identifying the vascular systems during imaging tests and other surgical operations. Surgeons and radiologists can benefit from the morphometric and morphological differences observed during radiological evaluations and surgical procedures.

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| Morphometric variables          | Fissure of Gan's | Porta hepatis | Venous fissure/ Fissure for ligamentum venosum | Umbilical fissure/ Fissure for ligamentum venosum | Any other accessory fissure |
|---------------------------------|------------------|---------------|------------------------------------------------|---------------------------------------------------|-----------------------------|
| Depth range (cm)                |                  | 1.5-2cm       | 1.1-1.2cm                                      | 0-3cm                                             |                             |
| Mean depth (cm)                 | 1mm              | 2cm           | 2.3cm                                          | 1.7cm                                             | 1mm                         |
| Width range (mm)                | 0-3mm            | -             | 7-10mm                                         | 1-10mm                                            | 0-2mm                       |
| Mean width (mm)                 | 1mm              | -             | 7mm                                            | 4.3mm                                             | 1mm                         |
| Circumference/ range of length  | 0-6.3cm          | 8.3-12.8cm    | 4.2-9.3cm                                      | 2.6-7.2cm                                         | 1.3-5.5cm                   |
| Mean circumference/ length (cm) | 3.1cm            | 10.4cm        | 6.3cm                                          | 4.9cm                                             | 3.5cm                       |

Table 1: Morphometry of the fissures seen on the surface of the liver in study specimens

| Morphology variables                                        | Fissure of Gan's                                     | Porta hepatis          | Venous fissure/ Fissure for ligamentum venosum | Umbilical fissure/ Fissure for ligamentum teres | Any other accessory fissure                                                                      |
|-------------------------------------------------------------|------------------------------------------------------|------------------------|------------------------------------------------|-------------------------------------------------|--------------------------------------------------------------------------------------------------|
| Hepatic tissue bridge over fissure                          | Absent                                               | Absent                 | Absent                                         | Present in 20% (n=12) specimens                 |                                                                                                  |
| Structures passing through fissures/content at fissure base | Absent                                               | Present in 100% (n=60) | Present in 100% (n=60)                         | Present in 100% (n=60)                          | Absent                                                                                           |
| Shape                                                       | Thin scar like in 10 and curvilinear in 36 specimens | Elliptical/oval        | Curvilinear/ oblique                           | Curvilinear                                     | Oblique                                                                                          |
| Absent/present                                              | Present in 76.6% (n=46/60)                           | Present in 100% (n=60) | Present in 100% (n=60)                         | Present in 100% (n=60)                          | Other than fissure of Gan's, other multiple accessory fissures were seen in 30% (n=18) specimens |

Table 1: Morphology of the fissures seen on the surface of the liver in study specimens