The bile duct is a thin and delicate tube that carries bile from the gallbladder into the intestine. Surgery in this area, for whatever reason, can sometimes damage the bile duct. This happens, for example, in one in every one thousand people who have a laparoscopic cholecystectomy. A repair or reconstruction of the bile duct is then planned and this can be done using laparoscopic techniques or robotic surgery.

Why is bile duct repair or reconstruction necessary?
The bile duct can be injured during the course of another operation or because of an underlying illness:

- **Laparoscopic cholecystectomy**: this is a complication in 0.1% of laparoscopic gallbladder removal surgeries
- **Liver surgery**: any surgery to the liver, such as removal of a cancerous tumour, carries the risk that the bile duct may be injured
- **Obesity surgery**, such as duodenal switch or gastric bypass
- **Pancreatic surgery**, to treat pancreatic cancer or chronic pancreatitis
- Gallstones can pass into the bile duct and cause chronic inflammation narrowing of the duct
- Cancers that arise in the bile duct (cholangiocarcinoma) can lead to obstruction and need to be removed.

When bile cannot get into the intestine, the waste materials it contains are retained in the body. This causes jaundice, which causes the whites of the eyes and the skin to turn yellow.

Surgical challenges involved in repairing the bile duct
Any surgery on the bile duct itself is complicated because the anatomy of the liver is complex and because the duct is very closely associated with the blood vessels that are connected to the gallbladder and liver. The liver carries out hundreds of different functions, so its blood supply is very rich. It is normal for the bile duct to be surrounded by a tangled network of arteries and veins. Cutting one of these would cause more problems, so it needs to be avoided at all costs.

This means that the surgery involved in bile duct repair and reconstruction is very delicate and needs to be done slowly and carefully. Surgeons who specialise in bile duct repair now favour robotic surgery. Using a robot during the operation means that the surgeon can make very slow, very small and highly accurate movements with the surgical instruments. More accuracy can be achieved using robotic surgery than by the best surgeon working by hand alone.

Bile duct repair
Microsurgery techniques can be used to repair any tears in the bile duct by using fine stitching. This must prevent any loss of bile from the duct and into the body cavity, but it must not be too tight to prevent bile flowing through the space inside the duct.

Bile duct reconstruction
If the bile duct is very badly damaged and needs to be removed, it has to be replaced by a reconstructed tube made from a piece of small intestine. This is called a Roux-en-Y loop and also involves connecting up all of the smaller ducts that lead from the liver so that they empty into the small intestine.

Blocked Bile Duct
The bile duct is the tube that connects the liver to the bowel and is responsible for the drainage of bile. In the latter third of its course it traverses the head of the pancreas. It can be blocked (blocked bile duct) by benign conditions such as gallstones or strictures related to stone disease, but more worryingly can be blocked by cancers arising in the head of the pancreas, the bile duct itself (cholangiocarcinoma) or around its opening into the duodenum (peri-ampullary tumours). If it became blocked the patient would become yellow (jaundiced) in a matter of days, their urine would become dark and their stools pale. Intractable itching is also associated with worsening jaundice. A specialist Medical opinion and urgent investigation is mandatory if these symptoms develop.

Robotic bile duct repair and reconstruction
Mr Charles Imber uses the da Vinci® robotic surgery system. This is not a robot in the sense that an operation is done automatically with a computer program. The robot is a surgical tool that an experienced surgeon uses to carry out the operation.

A robotic surgery system is an extension of the surgeon's own hands. The robot has controls that look a bit like joysticks and these allow the surgeon to make quite large movements that only move the surgical instruments a very short distance. This means that the surgeon has very good control of exactly where cuts are being made, so it makes the surgery more accurate.

The camera system used in the da Vinci® system also magnifies the inside of the body, allowing the surgeon to see the tiny blood vessels more clearly, so there is less chance of injuring one of them.